THESISFORM.S.(OBSTETRICSANDGYNAECOLOGY)

SESSION 2020-

2023ASSESSMENTOFCOLOURDOPPL

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FLOWMETRIC INDICES IN FIRST TRIMESTERTHREATENEDABORTION

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ACKNOWLEDGEMENT

As I begin,I regard it to be an honor to be a part of Santosh Medical College &Hospital,providingmeendlessopportunities,andthenecessaryinfrastructureandresourcest o accomplish myresearch work.

Firstly, I would like to express my sincere gratitude to my guide, Dr. Manisha Gupta forher continuous support, motivation, enthusiasm and immense knowledge throughout mypost-graduation course and related research. Without her guidance and persistent helpthis thesis would not have been possible. Her dedication and keen interest but above allheroverwhelmingattitudetohelphasbeensolelyandmainlyresponsibleforcompleting my work. I could not have imagined having a better advisor and mentor formypost-graduationstudy.Itsmyprivilegetohaveworkedunder herguidance.

I owe a deep sense of gratitude to my co-guide Dr. Neelima Agarwal for providing mewith lots of constructive suggestions and comments on the content of thesis with herprofessional experience and extensive knowledge and guidance which helped me inallthe time of research and writing of thesis. Her timely advice and scholarly advicehelpedmeto agreat extent to accomplish thistask.

I place on record, my sincere gratitude to my coguide Dr. Alpana Agrawal for hervaluableassistance,insightfulcommentsandencouragement.Ioffermysincereappreciatio nto herformoldingme togo beyondmylimits and todream forthebest.

I am also thankful to Dr. Ashish Kumar Shuklafor helping me in accomplishing mywork.

I would also like to extend my gratitude to my seniorsDr.Trisha, Dr. Arpita , Dr.Ankita, Dr Parul, Dr Vaishali and Dr Anshul for their constant support and valuableinputs.

I am grateful to my Mother Mrs Aparna Mishra and my In Laws Dr. Akhilesh Dube andDr. Meenakshi Dube for always supporting me, believing in me and motivating me.Their values and teachings will always guide me towards working hard throughout mylife.

A special thanks to my husband Dr Saumitra Dube forguiding me, motivating me andforalways believingin me.

I would also like to thank my brother in law Dr Santosh Kumar and my Sister in law DrSonal Dube and also my brother Mr Shobhit Mishra and my Sister in law Mrs SakshiGoyalfortheirguidanceandsupport and constantmotivation.

This dissertation appears in its current form due to the assistance of several people, Iextend my love and gratitude towards my seniors, my colleagues Dr. Sadhana Pilla, Dr.Shams Jahan and Dr. Apurva Garg and my juniors Dr. Manvi, Dr. Sovia, Dr Aishwarya,Dr Chanchal,Dr Manish and Dr. Mimansha who helped me in completing this thesiswithinterestingideas and joyful company.

IalsowanttothankmyfriendsAnurimaDas,Arpita,Dr.ChShivani,Dr.Shifali,DrHua Phen, Dr Ritika, Dr Vandana, Dr Sweta, DrVarsha, Dr Astha, Dr Aafreen, DrSrishtifortheirconstant motivation andsupport.

Lastly,Ifeelprivilegedforthepatienceandcooperationofallpatientsandtheirrelatives/guardians for trusting me with all their valuable information and opening up tome.

Last but not the least I thank the Almighty for making these wonderful people cometogetherto myaid to makethis ventureasuccess.

Dr.ShubhangiMishra

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ABBREVATIONS

Sp A- Spiral

ArteryUtA- Uterine

ArteryPI-

PulsatilityIndex

SD- Systolic/Diastolic

ratioRI-Resistance Index

LMP- LastMenstrualPeriod

ROC- Receiver Operator

CharacteristicsGA-Gestational Age

BP-BloodPressure

FGR- Fetal Growth

RestrictionTVS- Trans Vaginal

UltrasoundPOG-Period

ofGestation

EDD- Expected Date of

DeliveryP/A-Per Abdomen

P/S- Per

SpeculumP/V- Per

VaginumUSG-

Ultrasound

OR	Odd'sratio
CI	Confidenceinterval
SES	Socioeconomicstatus
HDP	Hypertensivedisorderofpregnancy
APH	Antepartumhemorrhage

PEPreEclampsia

EVT Extravillous

TrophoblastCW Continuous

Wave DopplerPW Pulsed

WaveDoppler

CDI Colour Doppler

ImagingPSPlacentalSyndrom

e

INTRODUCTION

INTRODUCTION

Normal implantation and placentation are crucial for the successful outcome of pregnancy.Suboptimal implantation and placentation can result in miscarriage or complications in latepregnancy,likepretermdeliveryorpreeclampsia[1]Placentationprovidesuteroplacentalcirculation and allows the trophoblast to come in direct contact with maternal blood. Acombinationofcellularandmolecularsignalsaffectsimplantation.Blastocystinvasionincludes sex steroids, peptide hormones, growth factors, cytokines and immunological factors[(2-4)]. Excessive invasion resulting from improper implantation countering the invasion ofblastocyst by maternal tissues leads to placenta accreta or percreta. Inadequate invasion leadsto miscarriage, preeclampsia or premature birth. Although the regulatory mechanisms are notfullyunderstood,thereisanessentialneedtodevelopandvalidateteststoidentifypregnanciesthat areat high risk formiscarriageorcomplications[1,5,]

Placenta syndrome (PS) is a collective term for placenta-insufficiency related disorders, ispoorlyunderstood.InadequateremodellingofSpiralarteriesinplacentasyndrome-pregnancies potentially affects the development of the placenta as high velocity blood flowcouldproducemechanicalstressonthetissue,orcouldaffectdevelopmentleadingtoperfusion-reperfusioninjury[6-9]

Many congenital and acquired changes in the vascular wall of the endometrial spiral arteriescan affect insufficientfetal implantation of the fertilized oocyte. Spiral artery blood flow isaffected by endothelial factors which change the velocity of the blood flow and can affectthrombosis[5].

Information of normal maternal, uteroplacental and fetal hemodynamics and their physiologicchanges during the first trimester of pregnancy is crucial for understanding early humandevelopment and many pregnancy complications. Evidently increased oxygen and nutrientdemands of the growing embryo are maintained by increased maternal cardiac output, plasmavolume and red blood cell mass as early as the first trimester [10,11]. The uterine vasculature,furthermore, is induced by the changes in placental vascular tone and in the endothelial andmuscular properties ofthesevessels[10].

According to the World Health Organization (WHO), "miscarriage is the loss of a pregnancybefore 20 weeks of gestation or fetal weight below 500 g"[5,12]. Threatened abortion is one themajor problem in obstetrics andapplies to 1/3[rd]ofall pregnancies[13].

ThreatenedAbortionisoneofthemostcommoncomplicationinearlypregnancy.Itsincidencevaries between20-25%.Themaincausesofvaginalbleedinginearlypregnancyare sub chorionic haemorrhage, sub chorionic haematoma and rupture of a marginal placentalsinus. In majority cases of threatened abortion bleeding is of unknown origin and usuallyslight.Most ofthesepregnancies continuetill termwith or withouttreatment[14,15].

Due to the high occurrence of spontaneous miscarriage in the threatened abortion group ofpatientsa techniquethatcouldpredictpregnancy outcome inearly gestationwouldbe ofgreatclinicaladvantage.TransvaginalColorDopplerultrasonographyhaspermittedassessment of uteroplacental circulation in early pregnancy, irregularities of which have beenlinked to pregnancy complications such as hypertension, fetal growth restriction (FGR), fetaldistress, and early pregnancy failure [(2-4)]. The capability of trans-vaginal Doppler sonographytoanalyzethepatternofcirculationineventerminalbranchesoftheuteroplacentalcircula tionhasencouragedresearchforitspotentialuseinpredictingearlyandlatepregnancy complications related to abnormal placentation. Impaired vascular remodelling inthe maternal - fetal interface is one of the most significant factors associated with early andlatecomplications in pregnancy.[3,5-7]

Hence, doppler ultrasound has developed as one of the most objective methods to assesspregnancies at risk for or affected by preeclampsia, intrauterine growth restriction (IUGR),fetal anemia, and other adverse perinatal outcomes. Doppler ultrasound gives knowledge onfetal and placental cardiovascular function on the basis of the vascular resistance of the vesselbeingassessed.

It is now widely accepted that the most common complications of pregnancy results due toabnormalities in early trophoblast invasion and persistently increased resistance of the spiralarteries[(-5]. The intent of this study was to measure the possible role in picking up the possiblemodifications in blood flow patterns in spiral arteries on trans-vaginal Doppler ultrasound atan early gestation so that early intervention can lead to decrease in perinatal mortality andmorbidity.

AIMANDOBJECTIVES

AIMANDOBJECTIVES

Theaimofthestudy“AssessmentofColorDopplerflowmetricindicesinfirsttrimesterthreatenedabortion “is-

- To study the Color Doppler flowmetric indices of spiral artery blood flow in firsttrimester(6–10 weeks)in cases ofthreatened abortion and normalpregnancies.

Theobjectivesofthestudy“AssessmentofColorDopplerflowmetricindicesinfirsttrimesterthreatened abortion”are-

- To compare and determine association between the Color Doppler flowmetric indicesof spiral artery blood flow in first trimester (6–10 weeks) in cases of threatenedabortionand in normal pregnancies.
- Topredicttheoutcomeofsuchpregnancies

REVIEW OF LITERATURE

REVIEWOFLITERATURE

Early pregnancy and the first trimester is the time with the greatest probability of fetal demiseandabnormaloutcomesinapregnancy.About20%ofpregnanciesmayhavesomecomplicati on in the first trimester. Symptoms such as vaginal bleeding and pain are the mostcommon presenting complaints which could point to a pregnancy complication. A systematicapproach is the key to regulate the status of the pregnancy and further care. The diagnosisdepends on the period of pregnancy, clinical background and results of investigations. Themanagement of early pregnancy bleeding depends on the diagnosis given at the time ofpresentation[16-20].

Worldwide, about 12–15 per cent of recognised pregnancies result in miscarriage. After amiscarriage 30 – 50 per cent of women encounter anxiety and 10 –15 per cent depression,typicallylastingforup tofour months[21].

Earlypregnancylosscanresultindifferenttypes.Inmissedabortion,thereisasymptomaticor „missed" death of the embryo or fetus without sufficient uterine contractions to push outtheproductsofconception[20].Spontaneousabortionisthelossofpregnancyoccurringnaturallybef oretwentyweeksofgestation.Spontaneousabortionissignifiedasa „miscarriage" to avoidconnection with induced abortion. Early pregnancy loss signifiesmainly to spontaneous abortion in the first trimester. Most spontaneous abortions occur in thefirst trimester[20].

Threatened abortion is described as symptomatic, „threatened" expulsion ofthe products ofconception, but the cervical os remains closed, and the embryo or fetus remains viable.Inevitable abortion is differentiated from threatened abortion by the presence of an opencervicalos,signifyingthe„inevitable"passageoftheconceptionproducts.Incompleteabortion , presents as an „incomplete" passage of the products of conception through thecervicalos.

Completeabortionisdefinedasa„complete"expulsionofallproductsofconception.Recurrent pregnancy loss, also known as recurrent miscarriage is defined as three or moreconsecutivepregnancylossespriorto20weeksfromthelastmenstrualperiod.Septicabortion occurs when retained products of conception become infected, which mostly occursin thelocation ofnon-sterile induced abortion[19].

A threatened abortion is defined as vaginal bleeding before 20 weeks gestational age in thesetting of a positive urine/blood pregnancy test. In this type of abortion the cervical osremains closed. The World Health Organization (WHO) definedthreatened abortion as"pregnancy-relatedbloodyvaginaldischargeorfrankbleedingduringthefirsthalfofpregnancy with closed os"[19,21]. Symptoms ofthreatened abortion include lower abdominalpain, and/or vaginal bleeding. Nearly 25 percent of pregnant women have some degree ofvaginal bleeding during the first two trimesters and about 50 percent of these progresses to anactualabortion.Bleedinginthistypeofabortionismildtomoderate.Patientscomplainof abdominal pain in the form of intermittent cramps, suprapubic pain, pelvic pressure, or lower backpain.[19,22,25-27]

A pelvic examination is mandatoryto conclude the type of abortion. Decisive factors are theamount and site of bleeding, whether the cervix is dilated or not, and whether fetal tissue haspassed or not. In a threatened abortion, the vaginal examination may reveal a closed cervicalos with no tissue[28]. In few cases, the pelvic examination will reveal uterine and bilateraladnexal tenderness. It is vital to note that in a threatened abortion there is no passage of tissueandthecervicalosis,bydefinition,closed[21].Theseobservationsdistinguishfromaninevitable or incomplete abortion. Women withthreatened abortion mostly have stable vitalsigns, but if hypovolemia is present, one should suspect bleeding or sepsis. The abdomen inmajorityofcases is non-tender and soft[19].

Thus, Threatened abortion is a riddle in obstetrics on which depends the fate of pregnancy. Itis one of the most common complications in the first trimester and early second trimester andthesewomen aremoreproneto abort in contrast to healthypregnancy[29].

Noseriousadverseeventsareassociatedwiththreatenedorspontaneousabortion.However,itcanlea dtoconsiderableemotionalstress[30].Therefore,severalbiochemical,ultrasonography, and clinical parameters have been investigated to predict the outcome ofpregnancy[31,32]. These tools help the physicians in giving proper and accurate affirmations of agood pregnancyoutcome.[32]

THEPLACENTA

After fertilization, the fertilized ovum develops into a morula, which then evolves into theembryo and fetal placenta. The inner cell mass evolvess into the embryoblast, and the outercellmassdevelopsintothetrophoblast.Themorulathenformsablastocystwiththetrophoblast surrounding the inner cell mass and fluid. The blastocyst implants into the uterusapprox six days after fertilization. The contact oftrophoblast with the endometrium results inthe development of the syncytiotrophoblast, which secretes human chorionic gonadotrophichormone (hCG) and the cytotrophoblast which secretes enzymes that break down the contactbetween endometrial cells such that the syncytiotrophoblast can invade the endometrial wall.Both the cytotrophoblast and the syncytiotrophoblast are part of the chorion, which evolvesintothe placenta alongwith the extraembryonic mesoderm.[33-35]

The cytotrophoblast raises into the syncytiotrophoblast as finger-like projections, known astheprimarychorionicvilli.Theextraembryonicmesodermdividesintosomaticandsplanchnic mesoderm, and the somatic mesoderm develops into the primary villi producingthe secondary villi. The mesenchyme produces blood cells and vessels, which assigns tertiaryvilli when formed. Capillary beds develop from the villi, which attach to the embryo heart.Maternal blood that flows through the embryonic capillaries gives oxygen and nutrients to thefetus.Thevillicontinuestogrowanddivideintothevilluschorion,thusthefetalplacenta.[36,37]

In the uterus, gradual change from low volume high resistance to high volume low resistancecirculation is important for normal pregnancy. The blood supply of the pregnant uterus issupplied by main uterine arteries which give off branches extending inward and dividing intoan arcuate arteries. Radial arteries arise from arcuate arteries and join spiral arteries, whichopen into the intervillous space. The major component of the fetal portion of the placenta ischorionic villus[10].

Oxygenation is the method of supplying molecular oxygen from air to the tissues of the body.In the fetus, this includes, first, oxygen transfer across the placenta, then reversible bindingof oxygen to fetal hemoglobin and fetal blood flow, and, third, oxygen utilisation for growthand metabolism. Energy is the resultant from the combination of oxygen and glucose to makecarbondioxide andwater. Removalof carbondioxide andguard against acidosisis bythe

reverse of the mechanisms for oxygen delivery and is aided by the rapid diffusion, highsolubility and volatility of this gas. In adults, carbon dioxide is removed by the lungs whilebicarbonate and hydrogen ions are excreted by the kidneys. In the fetus, both these functionsareconducted bythe placenta.[38]

Placentaisanimportantorganwithmanypurposes,suchasendocrine,immune,andphysiological.
The placenta is formed slowly during the 1st three months of pregnancy, while,afterthe4thmonth, it grows simultaneouslywith thedevelopment of the uterus.[36]

Placenta is a fetal tissue made up of parenchyma, chorion, amnion, and umbilical cord.Thefetal tissues develop from the chorionic sac - which involves the amnion, chorion, yolk sac,and allantois.[36]

The placental bed consists of the uterine spiral arteries that supply oxygenated blood to thegrowing placenta and fetus. Essential events occur in the placental bed throughout pregnancy.Extravilloustrophoblast(EVT)cellsgrowfromanchoringchorionicvilliandenterthede cidualizedendometriumby2pathways:interstitialEVTcellsenterthedecidualizedendometrium and inner myometrium, and endovascular EVT cells enter the lumen of thespiral arteries. Some EVT become assimilated into the spiral artery well as the intramuraltrophoblast. The endothelium, vascular smooth muscle, and elastic lamina are damaged andrestored by fibrinoid. EVT cell invasion is said to be contributory in the transformation of themuscular spiral arteries into distended, thin-walled flaccid vessels. Remodeling is importantforasuccessfulpregnancy.[18]

Downstream remodeling of the spiral arteries decreases utero-placental resistance extremelyand permits significant increase in volumetric blood flow to the placenta[6,39-43]. Remarkably,somestudiesshowthattrophoblastinvasionisconcentratedinthecentralareaoftheplac entalbed,and incontrast peripheralmyometrial segmentsaremuchless changed.[44,45]

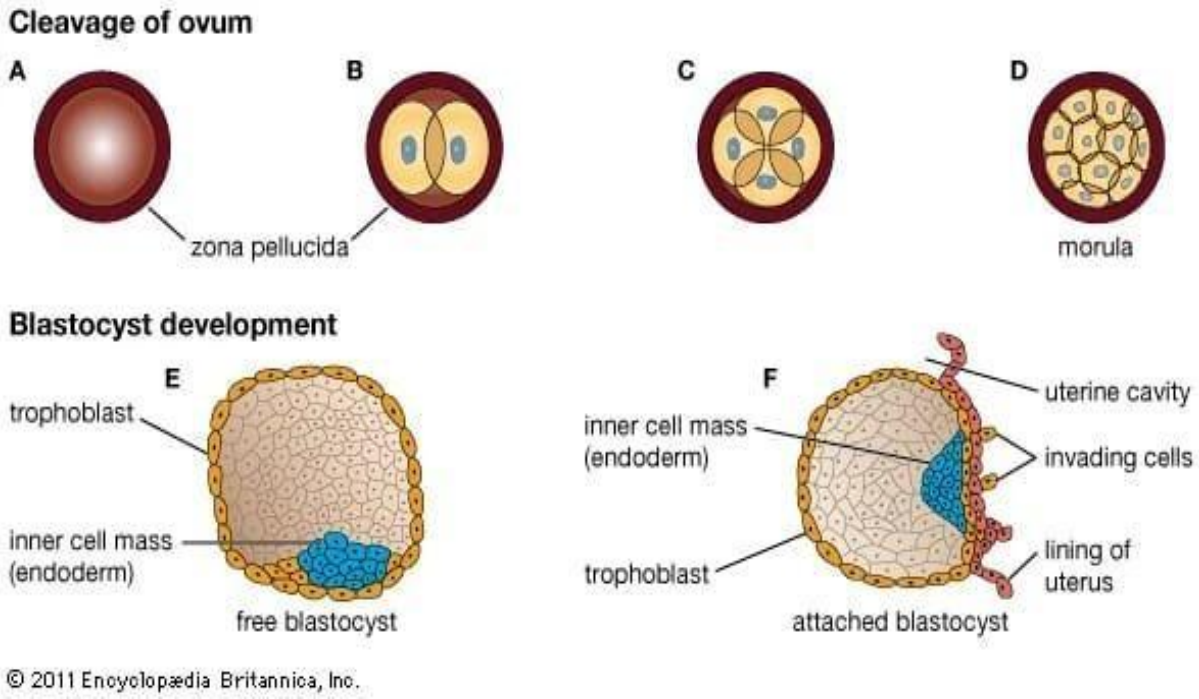


Fig 1:Formation of trophoblast and

blastocystReference:Encyclopedia

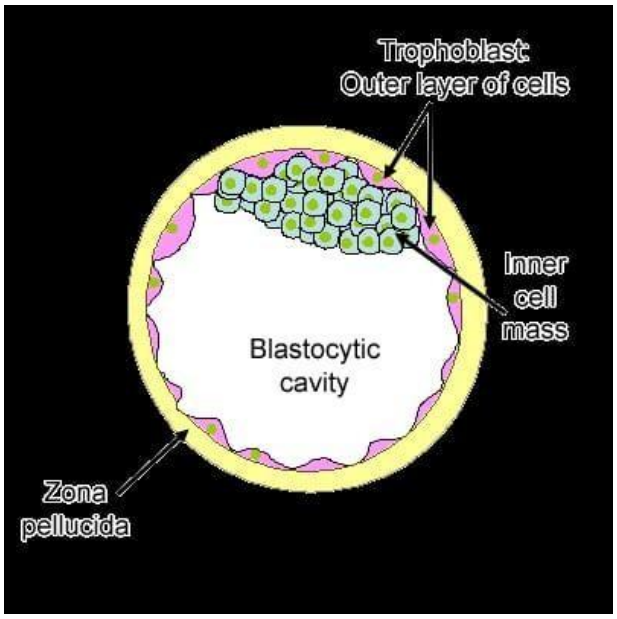


Fig2:FormationofblastocystRefere

nce: Encyclopedia

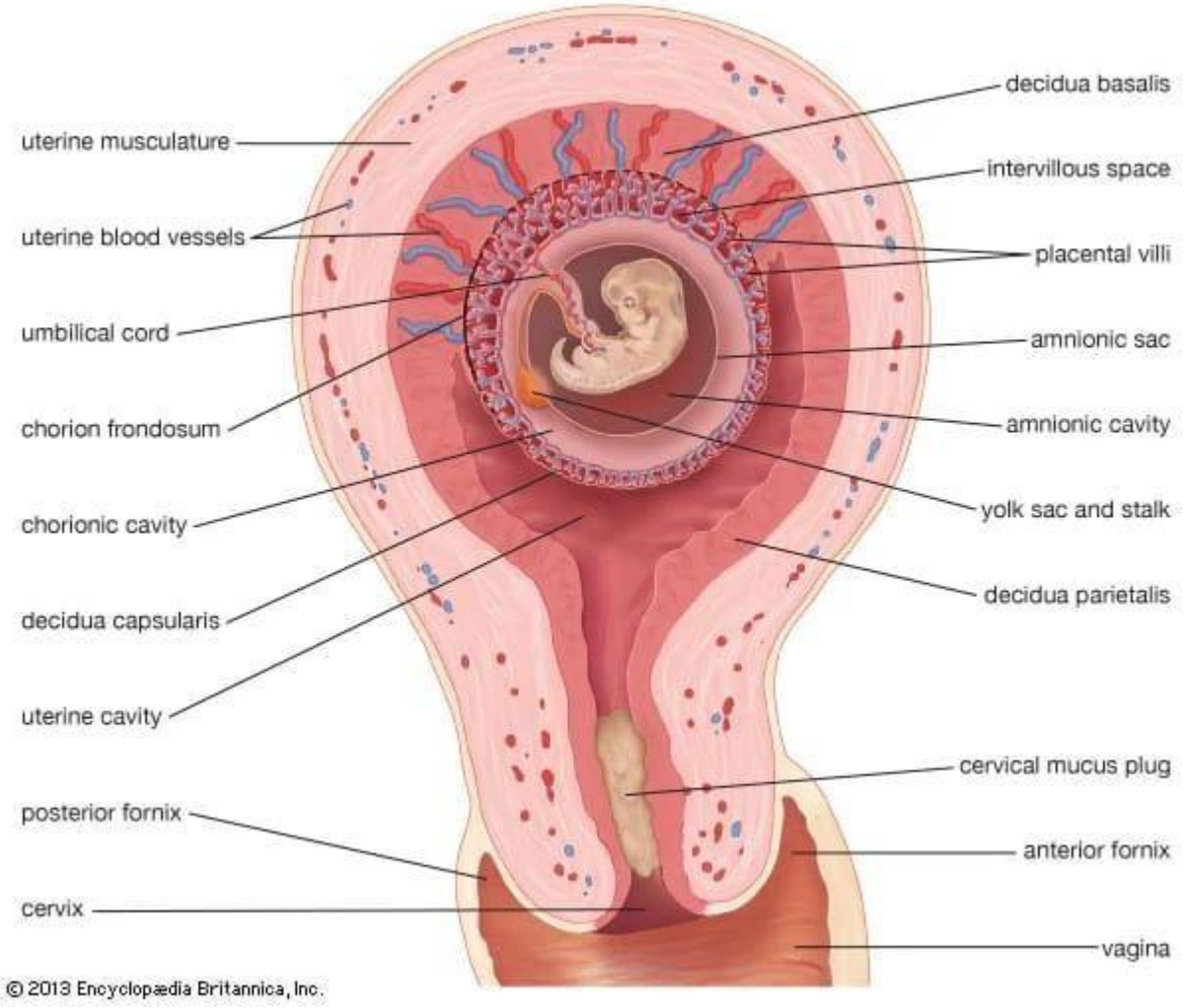


Fig 3: Gravid uterus showing the fetus and the deciduaReference:Encyclopedia

The gold standard for the early detection of absent oraberrant Spiralarteries remodeling isthe postpartum histopath exam of the placenta, though this is behind the time to make clinicaldecision making in endangered gestation[46]. Previous studies shows that abnormal Dopplervelocimetry of the more upstream uterine arteries in second trimester is related with anincreased risk on vascular pregnancy related complications (among which are pre-eclampsia(PE), fetalgrowthrestriction(FGR) andstillbirth)[47,48].Abnormaluterine artery Dopplerindicesduringearlygestationmayalso predictPreeclampsiaand Fetalgrowth

restriction[49,50].

AsdefectiveSpiralarteryremodelingfinallyrelateswithadversepregnancyoutcome,capturingthes eincompleteSpiralarteryremodelingantedatingcomplicatedpregnanciesduringearlier gestationmaycorrectlyindicate those at risk.

Preeclampsia, as by definition hypertension and proteinuria, affects 3% to 7% of pregnancies,gives a majority contributionto the maternal and fetal morbidity and mortality, andisaccountablefor50000deathsworldwideannually.Althoughpreeclampsiaismostlyassociated with fetal growth restriction (FGR), Fetal growth restriction can result in theabsenceofmaternalfeatures.Mothersandchildrenofapregnancycomplicatedbypreeclampsia have a long-term increased risk of cardiovascular diseases and premature death.Theoriginofpreeclampsiaisnotknownbutisstronglyassociatedofspiralarteryremodeling.Pr eviously, thought to be precise for myometrial vessels, suboptimal remodelinghas also been reported in decidual vessels. Unmodified/partially modified vessels can providehighorintermittentpulseofpressureflowandsoinjurytotheplacentaresultsfromhydrostatic stress or from changes in oxygen delivery.Three stageof preeclampsia has beenproposed. The first stage includes partly malfunction of the maternal immune tolerance toantigens expressed by paternally derived EVT. This results in reduced invasion of fetal EVTcells and decreased remodeling of uterine spiral arteries (stage 2) and finally a dysfunctionaluteroplacental circulation with oxidative stress and production of factors released into thematernal circulation (stage 3). Hence, Doppler ultrasound has appeared as one of the mostactual methods to measure pregnancies at risk for or affected by preeclampsia, intrauterinegrowthrestriction(IUGR),fetalanemia,andotheradverseperinataloutcomes.Doppler ultrasoundoffersinformationonfetalandplacentalcardiovascularfunctiononthebasisofthe vascular resistanceofthe vessel beingassessed.[17]

TransvaginalUltrasoundinEarlyPregnancyBleeding

TVSColorDopplerallowsnoninvasivestudiesofphysiologicalchangesintheuterinecirculation. Abnormal uteroplacental circulation and alterations in the morphology of thevessels maybeinvolvedinthepathogenesis of somepregnancycomplications[10].

Ultrasonography is mostly the single most crucial investigation in a woman with bleeding inearly pregnancy. It should generally be done transvaginally since the imaging quality andaccuracyisgreaterto transabdominalroute. A pregnancyisgenerallyseenwith nearly100%

accuracy at 5.5 weeks of gestation and generally at 5 weeks of gestation. This can be relatedtotheserumβ-hCGlevels.Atlevelsmorethan1500IU/L,apregnancyshouldalwaysbeseen with a 6.5 MHz transvaginal probe. If an intrauterine pregnancy is not seen, an ectopicpregnancy should be strongly suspected. A serum β-hCG level of below 800IU/L; in whicheven a healthy intrauterine pregnancy is not seen. Serum β-hCG levels between 800 and1500IU/Lisknownasthediscriminatoryzone.Iftheserumβ-hCGisindiscriminatorylevel, then the ultrasoundimagingmaynot beconclusive.[16]

The normal growth of intrauterine pregnancy in the first few weeks are crucial to understandand interpret theimages to help establish a diagnosis in earlypregnancybleeding.[16]

Therefore, use of TVS color doppler has helped in early detection of adverse pregnancyoutcomes.

DOPPLERULTRASOUND

The history of ultrasound in Obstetrics and Gynaecology dates from the 1958 Lancet paper ofIan Donald and his team from Glasgow.Technological developments such as solid statecircuitry, real time imaging, colour and power Doppler, TVS and 3/4D imaging have beenseized by clinical researchers to improve the investigation and management of patients inareas as various as assessment of fetal growth and wellbeing, screening for fetal anomalies,likelihood of pre-eclampsia and preterm birth, detection of ectopic gestation, evaluation ofpelvic masses, screening for ovarian cancer and fertility management. Ultrasound guidedproceduresarenow important components offetaltherapyandIVFtreatment.[17]

Before Donald; Thomas Young in 1801 described “phase shifting” in relation to light wavesbut this thought was used in ultrasound phased array systems to control interference patternsandisusedintheproductionof3Dimages.ChristianDopplerin1842explainedwhatwecall the “Doppler effect” in relation to the motion of stars but this concept is now used as thebasis for blood flow studies in pelvic vessels and the fetus. Pierre Curie in 1880 explained thepiezo electric effect whereby mechanical distortion of ceramic crystals would produce anelectriccharge; the reverse of this effect is used in all transducers toproduce ultrasonicwaves. His pupil Paul Langevin in1915 built the first hydrophone which utilised ultrasonicwaves to discover the position and distance of submarinesand is the origin behind themeasurementofthefetusandabdominal massesbyultrasound.TheadvancementofRadarby

Watson-Wattandhisteamusingelectro-magneticwavesin1943waslateradaptedforultrasoundto producetwo dimensional images.[17]

Donald and his team with the advantage of priority made some early breakthroughs and in1963 had explained the early diagnosis of hydatid mole (with its snowstorm appearance),assessment and development of the early gestation sac (by the full bladder technique) and thediagnosis of early pregnancy complications (Donald, 1962). Placentography: Precise locationof the placenta was the holy grail of antenatal diagnosis in the early 1960‟s for placentapraevia was the cause of significant maternal mortality due to severe haemorrhage in lategestation. Many radioisotope techniques were used at this time but they were unable toprecisely define the lower placental edge. Ken Gottesfeld et al in 1966 published the firstpaper on ultrasound placentography (Gottesfeld et al., 1966) though they were unable tovisualise the posterior placenta (posterior praevia was implied by a space posterior to the fetalhead) and it was not till 1968 that Donald and Usama Abdulla in a larger study (Donald andAbdulla, 1968) and with their superior equipments were able to show placenta in all thelocations evenincludingthe posterior praevia.[17]

Early pregnancy: Kratochwil by using the transvaginal transducer demonstrated fetal cardiacmotion by the A-scan from 7 weeks gestation in 1967 but many studies in the 60‟s and early70‟swerecarriedoutabdominallybythefullbladdertechnique.ForexampleBangand Holmfrom the Copenhagen school reported that they identified the fetal heart beat from 10 weeksgestationin1968(BangandHolm,1968).Theinfluentialworkonearlypregnancyassessment came from Hugh Robinson from the Glasgow school. In 1973 using an improvedDiasonograph he created the first detailed biometry charts of the fetal crown-rump lengthfrom 7 to 16 weeks gestation; his measurements were so accurate that they are still in usetoday (Robinson, 1973). Using the combined A- and B-mode equipment he subsequentlymade charts of the fetal heart rate from 7 weeks gestation and showed that the detection ratewas 100%. He was the first to point out the prognostic significance of discovering a fetalheartbeat at 8 weeks gestation in relation to subsequent fetal demise (Robinson and Shaw-Dunn, 1973). His work had profound influence effect on the management of patients withthreatenedabortion.[17]

DOPPLER

A number of methods have been developed which exploit the shift in frequency of ultrasoundwhenitisreflectedfrommovingblood.Thisfrequencyshiftiscalledthe„Dopplereffect“.[5] [1,52]

Fivetypesofdiagnostic Doppler instrumentare mostlydistinguished:

1. Continuouswave(CW)Doppler
2. Pulsedwave(PW) Doppler
3. DuplexDoppler
4. ColourDopplerimaging/CDI
5. PowerDopplerimaging

The characteristics of an ultrasound beam, the propagation of ultrasound in tissue and thedesignoftransducersasfound inB-modeimagingareall significantforDopplertechniques.

THEDOPPLEREFFECTANDITSAPPLICATION

For all waves like sound or light the Doppler effect is a change in the observed frequency ofthe wave because of motion of the source or the observer. This is either due to the sourcestretching or compressing the wave or the observer meeting the wave more quickly or slowlyas aoutcome of their motion. In basic medical use of the Doppler effect, the source andobserver (receiver) are a transmitting and a receiving crystal mostly positioned next to eachother in a hand-held transducer (Fig. 4). A continuous cyclic electrical signal is applied to thetransmitting crystal and thus a corresponding CW ultrasound beam is generated. When theultrasound is scattered or reflected on a moving structure within the body, it encounters aDoppler shift inits frequency and returns tothe receiving (detecting) crystal.Reflectedultrasound is also detected from static surfaces within the body but it has not experienced aDoppler shift in frequency. After the reflected ultrasound is received, the Doppler instrumentpartsthesignals from staticandmovingstructuresbyexploitingtheirdifferent frequencies.

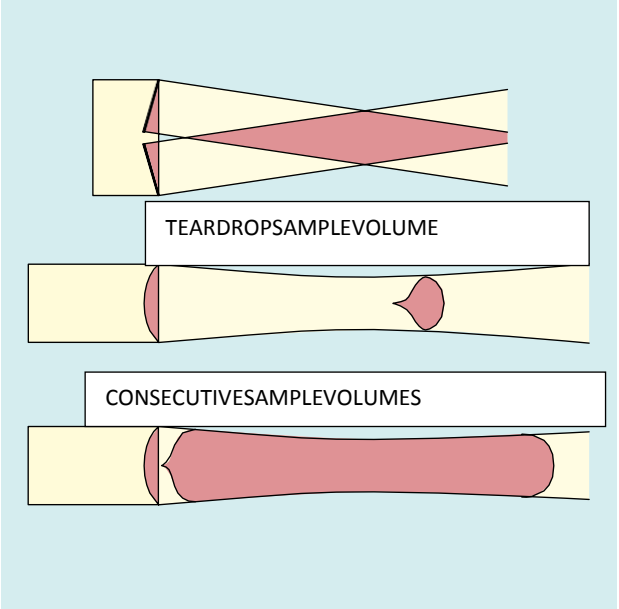


Fig.4 SamplevolumesinDopplertechniques.
(a)For dual crystalcontinuouswaveDopplerunit.
(b) ForpulsedwaveDopplerunit.
(c) NeighbouringsamplevolumesalongabeamforimagingDopplerunits.

CONTINUOUSANDPULSEDWAVEDOPPLERINSTRUMENTS

Doppler blood flow instruments are esential to be extremely sensitive and to be capable ofdetecting weak signals from moving blood in the presence of much stronger signals fromstatic or moving tissues; the latter gives rise to low frequency Doppler shift „clutter" signals.The magnitude of the scattered signal from blood is usually 40 dB belowthat is receivedfrom soft tissues, i.e. the blood echo amplitude is typically one-hundredth of the soft

tissueechoamplitude. ThedB unitis ameasureofsizeofasignalthat isrelativetoanother signal;

the second signal is usually a reference signal or perhaps the input signal to an amplifier towhichtheoutputiscompared.Bloodflowsignalsmaybediscoveredeventhoughthevesselis not clearly shown, for instance in the fetal brain, or the renal artery of the neonate. ThetransducerofabasicContinuousWaveDopplerunithastwoindependentpiezoelectriccrystals. Since the transmitting crystal is repeatedly driven to generate a continuous wave ofultrasound, a second crystal is used to detect the reflected ultrasound. When a ContinuousWaveDopplermodeisimplementedaspartofanultrasoundsystemwhichusesarraytrans ducers, separate groups of array crystalelements are used for the transmission andreception. On extraction of the Doppler shift frequency a filter, the „wall-thump" filter, isusually used to remove large, low-frequency components from the signal, such as those fromslowly moving vessel walls. Normally in a Doppler unit operating at 5 MHz, Doppler shiftfrequenciesbelow100Hzareremovedbyfiltering.BasicContinuousWaveDopplerinstrument saresmallandinexpensive;ContinuousWaveDopplermodefacilitiesareincorporatedintosomearra ysystemstoallowthemtodetecthighvelocities.Inthetransmitted ultrasound field and in the zone of maximum receiving sensitivity ; they overlapfor a particular range in front of the transducer (Fig. 4). Any moving structure within thisregion of overlap will provide a component frequency to the total Doppler signal. The shapeof the region of overlap (the beam shape) might be considered as having a crude focus whichdepends on the field and zone shapes and on their angle of orientation to each other. Inpractice, the beamshapesare rarely wellknown for ContinuousWave Doppler transducers.A 5 MHz blood flow instrument can be focused at a distance of 2 or 3 cm from the transducerand a 10 MHz device at a distance of 0.5–1 cm. Continuous Wave Doppler instrumentsnormally have ultrasonic output intensities (Ispta) of less than 10 mW cm-2 although theymight be significantly higher when used in conjunction with duplex systems to measure highvelocities. A Pulsed Wave Doppler instrument, operating with 5 MHz ultrasonic pulses, mayhave a pulse repetition frequency (PRF) of 10 000 s-1, i.e. 10 kHz.The highest velocity thatthe instrument can measure is directly proportional to its PRF , therefore the PRF is made ashigh as possible while still avoiding the overlap between the successive echo trains. Echosignals, like in trains of echoes, are produced as a transmitted pulse passes through reflectinginterfacesandregionsofscatteringtargets.Afteramplification,successiveechosignalsfro ma specific depth are chosen by electronic gating and the Doppler shift frequency is extracted.PulsedDopplerdevicesmight be usedon theirownbyalteringslowlythebeam directionor

the gated range depth while listening to the output, for example in transcranial blood flowstudies. Identification of vessels is made easier by combining the Pulsed Wave Doppler modewith a real-time B-scan mode to form a duplex system; however, this obviously adds to thecost and complexity. Since the ultrasound is pulsed and the excitation time is short, a stand-alone Pulsed Wave unit uses a single crystal transducer for transmission and reception (Fig.4b). In the setting the electronic gate to select a signal from a specific range, reflectors withinavolume,calledthesamplevolume,contributetothesignal.Theshapeandsizeofthesample volume are determined by a list of factors: the transmitted pulse length, the beamwidth, the gated range length, and the characteristics of the electronics and transducer. Thesample volume is usually described as a tear drop in shape (Fig. 4b).The Sample volumelengths are normally altered by changing the gated range length. In a blood flow unit forsuperficialvessels,thesamplevolumelengthcanbeasshortas1mm,whereasinatranscranial device it can be 1 or 2 cm; however, the precise lengths are rarely known. Theultrasonic output intensity of Pulsed Doppler instruments differs considerably from unit tounit .The intensity may normally be a few hundred mW cm-2 but can be as high as 1000 mWcm-2, particularly when they are required to penetrate bone, as in transcranial Doppler. AtpresentthemostcommonuseofstandalonePulsedWaveunitsisintranscranialexaminationsof cerebralvessels.

INFORMATIONFROMDOPPLERSIGNALS

When the Doppler signal containing information on blood velocities and haemodynamic isbeing produced it is necessary to interpret it. It is important to obtain good-quality signals inorder to be able to detect disease. The spectrum analyser aDoppler signal may be consideredinto its frequency components in order to give a display of the velocities of the blood cells ateach instant. Short time intervals of the Doppler signal is analysed, like a segment of 5 msduration. This produces an instantaneous spectrum of the frequencies in the given samplevolume. If the angle correction is thus applied, this spectrum will represent the range ofvelocities in the sample volume. The range of frequencies in every spectrum is then displayedon the vertical axis and the power of each frequency component is presented as a shade ofgrey. The consecutive velocity spectra are then displayed as side-by-side grey-shade lines.

Inthefollowingwayaspectraldisplay,orspectrogram,isbuiltup(Fig.1.7).Notethedifferencebetwee n theinstantaneousvelocityspectrum whichinforms us aboutthepattern of

velocities in the sample volume at that instant and the spectral display or spectrogram, whichshows how the velocity pattern varies with time. Spectrograms are produced in real timeduring the clinical examination and it is usually possible to store a few seconds of the trace inan analyser for subsequent review. The temporal resolution in a spectrogram, that is thesmallest apparent time interval, equals the length of the portion of Doppler signal used toproduce each instantaneous spectrum and is typically 5–10 ms. The frequency (or velocity)axis of the spectrogram typically has about 100 scale intervals each of 100 Hz. The Dopplersignalisthusresolvedintofrequencycomponentsseparatedby100Hz,thefrequencyresolution of the spectrogram. It is mostly desirable to make measurements on a spectrogram,for example an estimate of the time between two events or of the maximum velocity duringsystole or diastole. Measurement is achieved by placing a cursor on the relevant points ofinterest then a variety of calculations can be performed by the system computer. Indicesrelated to the spectrogram shape and therefore, to normality or abnormality of flow velocitiescan be calculated within the analyser and displayed on its screen.The oscillatory shape ofeitherspectrum oratracederivedfrom it isoften referredto asawaveform.

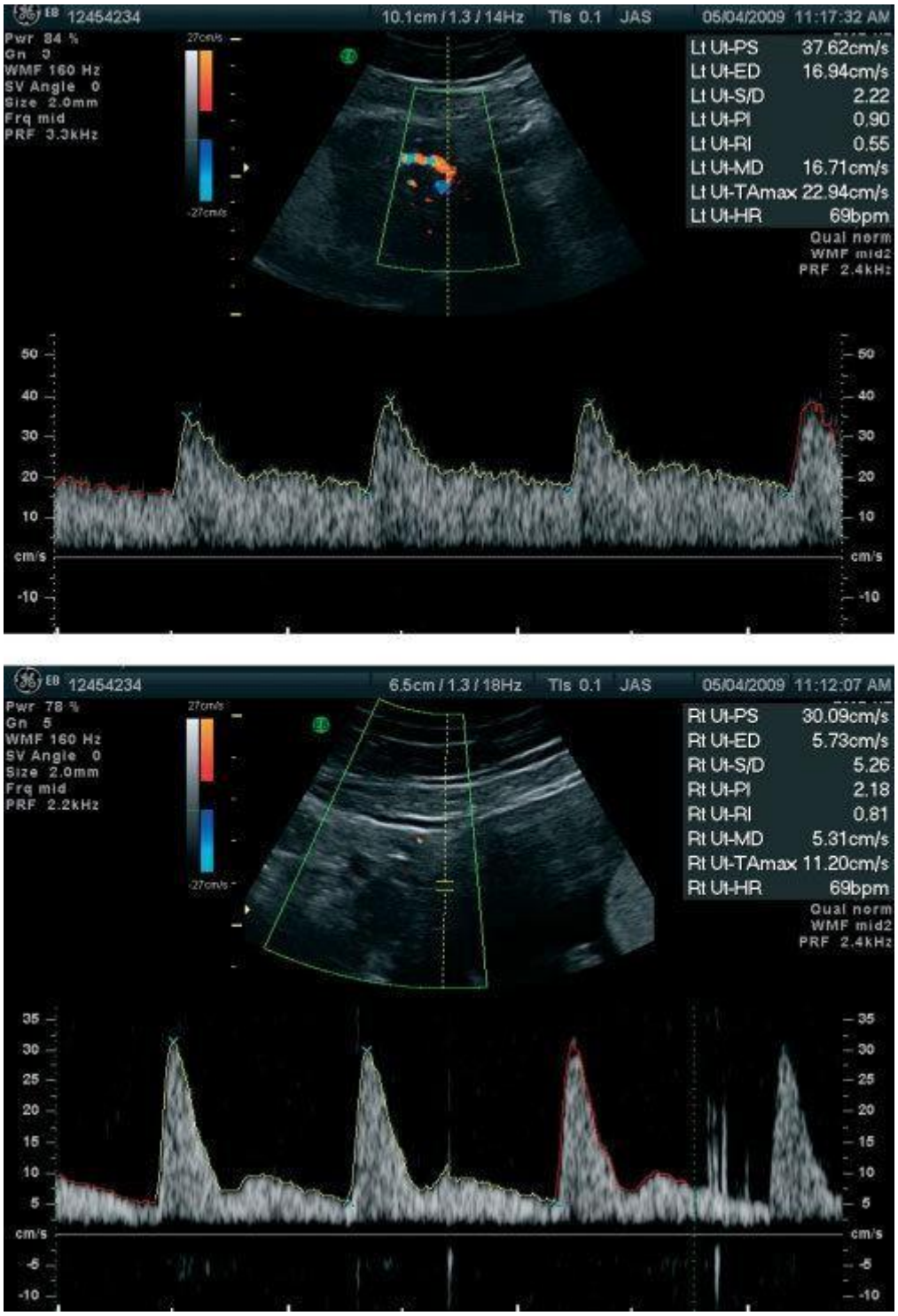


Fig5:DOPPLERFINDINGS INCASESOFNORMALINTRAUTERINEPREGNANCY

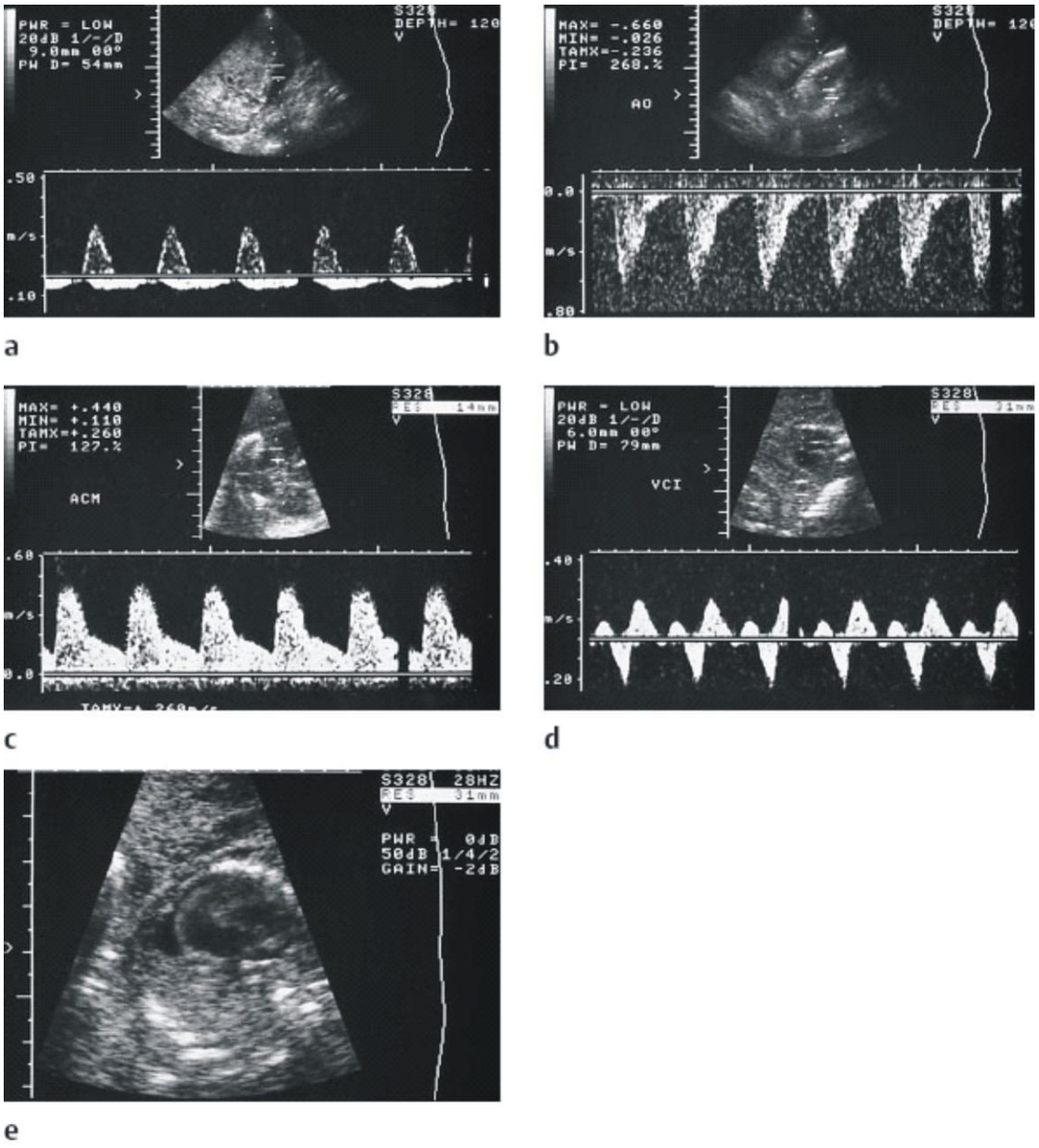


Figure6:ABNORMALDOPPLERFINDINGSINTHREATENEDABORTIONINFIRSTTRIMESTER

WAVEFORMINDICES

Waveformindicesareresultingfromacombinationofafewdominantfeaturesofthewaveform.Indicesthathavethesameorsimilarnamesintheliteraturearesometimesdefined differently, soa first step is tocheck the definition of any index to be used.Inpractice only two classes of index are used to the great extent, and those related to the degreeof diastolic flow and others related to spectral broadening. The variation in time of themaximum velocity displayed in a spectrogram is mostly used as asource of data for thederivation of an index (Fig. 8). As the maximum velocity is not always clearly apparent in aspectrogram, some analysers make a trace which is closely related to the maximum velocitytrace. One example is a trace showing the upper velocity boundary under which the velocitycomponentscontain seven-eighths of thepower of theDopplersignal.

The mean velocity waveform (average velocity waveform) is also active(Fig. 8).To analysethe mean velocity at every instant, the values of velocity and the intensities of the signal foreach velocity component in the instantaneous spectrum are used. The mean velocity is usedtogetherwiththevesselcross-sectionalareatocomputebloodflowrate.However,itishardto measure mean velocity accurately and there are several other problems associated withcalculatingflow rates.

Since the beam–vessel angle may not always be known, the waveforms or spectrogramswould not be corrected for angle. Indices are thus defined involving ratios of velocities. Insuch a ratio, the angle factors appear on both the top and bottom and therefore cancel eachother out, so that the index is independent of beam angle. Errors are also decreased byaveragingthecalculatedindices over severalheartcycles.

A/Bratio

TheA/Bratioisdefinedastheratiooftwospecifiedvelocities,likemaximumvelocities,attwopoints in thecardiaccycle.

Resistance index (RI) In

:RI=S– D/S

High resistance in the distal vessels creates low diastolic flow in the supplying artery andresults in a high value for this index; a low resistance results in a low value as there is higherdiastolicflow.It is also called as thePourcelot index.

Pulsatilityindex(PI)

Thepulsatilityindex (PI)isdefinedas:

PI= maximumvelocityexcursion/meanof thevelocity

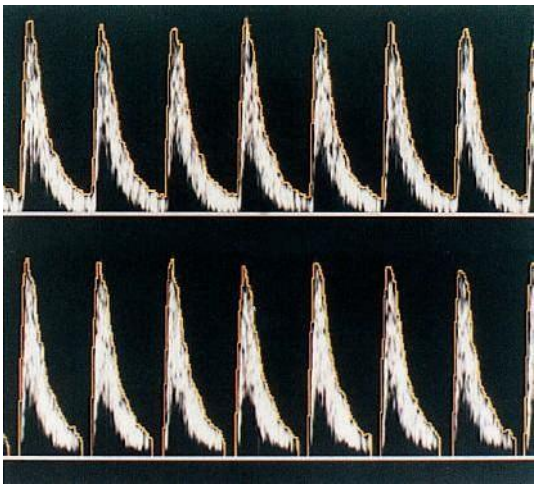


Fig7Filtering.Raisingthehigh-pass(wall-thump)filterasinthelowersonogramremoveslow-velocitysignals.
Reference:ClinicalDopplerUltrasound

It is used in vessels where reverse flow canoccur, like in the lower limbs (Fig. 8). The PImay normally have a value of 10 for the normal common femoral artery but might be around2when proximal diseaseseverelydampens thewaveform.

The PI index is heartrate dependent. To avoid this, PI can be calculated over a specified timefromthestartofsystole,likeforthefirst500ms.Thepulsatilityindexisthenidentified „PI(500)".

Dampingfactor

The damping factor is defined as the ratio of pulsatility indices at two sites along with anartery. Itquantifiesthedampingofthewaveformdownstreamalongwitha diseasedvessel.

Dampingfactor=PI(proximalsite) /PI(distal site)

The numerical value of this index surges as disease becomes more severe, a value of 2 beingtypical of a high degree of damping. This index is mentioned for completeness, it is notwidelyused.

Spectralbroadening

Turbulence increases the range of blood cell velocities in a given vessel. One index that canquantifythis broadeningofthe spectrum of velocities is:

Spectralbroadeningindex (atsystole)=maximumvelocity/meanvelocity

Assumptions with regard to the presence of turbulence should be made with caution and onlyafter familiarity has been gained with the patterns for laminar and plug flow for the particularinstrumentbeingused. Othertechnical factorscanleadtospectral broadening;like „geometricalspectralbroadening", whichresultsfromtherangeofDopplerangleswithwhichultrasound can insonate a sample volume in the vessel from points on the face of thetransducer.

Transittime

The time for the pulse pressure wave to travel along the length of artery can be calculated byplacing a Doppler probe at either end of it. From the starting of this time and knowing thelength, the pulse wave velocity (PWV) is calculated. Instead, using the electrocardiogram(ECG) and one Doppler unit the transit time can also be measured, the QRS of the ECGgiving the time when the pressure pulse leaves the heart. The time is first measured for thepulse to travel from the heart to the proximal artery site; the second time is then calculated forthe pulse to go from the heart to the distal site. Subtracting these twotimes provides thetransit time and, if the length of the artery is known, the PWV can be calculated. Any errorrelated with the assumption that the QRS represents the time at which the pulse leaves theheart is removed bythesubtraction.

A normal aorta has a PWV of approximately 10 m s -1. The transit time next to 0.5 m is then50 ms. Pulse wave velocity varies on disease states of the artery wall and blood pressure. Thisindex is also stated forcompleteness, it is not widelyused.

ARTEFACTSINDOPPLERTECHNIQUES

Artefactsareusuallyallocatedwithbyexplainingtheiroriginorbyrecognisingthattheyoccurfairlyfrequentlyand arenot of significance.

Attenuation

The reduction in echo signal size because of attenuation of the beam in tissue is very familiarfromB-modeimaging.ThesameattenuationprocessesoccurforDopplertechniques,therefore stronger signals are detected from superficial vessels than from deep ones. WithContinuous Wave Doppler units this imbalance cannot be compensated. With Pulsed Wavestand-alone and duplex Doppler devices, the signals are from a sample volume at a selecteddepthand theprofit can thereforebeadjusted to optimisethe signal.

Refraction

Refraction differs a beam as it crosses at an angle the interface between two tissues in whichthe speedof soundis different. The direction ofthe transduceraxis cannot, thus, coincidewith the actual beam path. This is less of a problem with colour or power Doppler imaginginstruments, since the occurance of a signal is noted first in the image before any spectralanalysisis attempted.

Shadowingandenhancement

Attenuation of a Doppler beam at a structure may be so huge that blood flow behind it cannotbe detected. Signal enhancement occurs where the beam passes through a medium of lowattenuationto reachthe vessel,likeacollection of amnioticfluid,orthefull bladder.

Beamwidth

A wide beam can contribute to the Doppler signal from moving structures well off the centralaxis. This is mostly due to a strong reflector such as a heart valve leaflet, but it could also bedue to a large blood vessel. A narrow beam may lead to only partial insonation of a vesselwiththerelated errors inthe Dopplersignal.

Spectralbroadening

Spectral broadening is another artefact that results from beam shape. As in the discussionbefore on the spectral broadening index, this arises due to ultrasound in the beam

insonating asamplevolumeover a rangeof angles.

Speckleand thespectraldisplay

The speckled appearance of a sonogram that results from fluctuations in the power levels ofthevelocitycomponentsinneighbouringpixels.Thesefluctuationsarebecauseoffluctuationsinth eultrasonicsignal receivedfrom therandom distributionof bloodcells.

Inadequatecoupling

Weak Doppler signals might be attributed to a lack of coupling liquid between the transducerand the skin. In Continuous Wave and Pulsed Wave Doppler applications this artefact is notasevident as in imagingtechniques, wherepoor penetration is readilyseen.

Electricalpick-up

Doppler devices are required to be highly sensitive and are therefore prone to electrical pick-up ofstraysignals.

Compressionofthespectraldisplay

When a sonogram is compressed, either in its grey shades or in its scale of presentation, datais lost. A sonogram should be treated as a type of image and is therefore presented withoptimum grey-shade contrast and spatial detail. The latter means that the velocity and timeaxis scales must be selected to show detailed structure in the sonogram. Theprecision ofmeasurementsfrom the sonogram will also beaffected bypoorpresentation.

Erroneousdirectionsensing

Thedirection-sensingcircuitrydoesnotalwaysfunctioncorrectlysinceitsdesignandimplementation are hard. Flow will then be obtained in the wrong direction, either in asonogramorinacolourDopplerimage;ifthisisassumedthentheset-upofthesystemcanbechecked byexamining anormal arteryin whichthe direction offlow is known.

Filtering

Filters are used to greatly reduce low frequencies, like those obtained from arterial walls.Filters alsoremove dataon slow-moving blood but this is not usually a serious problemunlessit is desired to measuremean velocityaccuratelyor slow flow specifically.

Harmonicgenerationbylargesignaldistortion

The harmonics of a frequency are superior multiples of that frequency; like, harmonics of 100Hz are 200 Hz, 300 Hz, etc. If a signal is big to be handled by the electronics it becomesdistorted and then contains additional harmonic frequency components. Strong blood flowsignals exhibit harmonic components as a higher frequency part of the sonogram above thatwhichwould probablybeattained ifthegain were reduced.

Highorlowsensitivity

IncolourDoppler andpower Doppler imaging, setting up the systemwith too low thesensitivity affects the blood flow signal to be lost. Too high a sensitivity leads to spuriousechoesto becolour coded as blood.

Aliasing

Pulsed Doppler and colour Doppler units are to reconstruct the Doppler shift signal fromregularly timed samplesof information,ratherthan the complete signalaswasused inContinuous Wave units. The sampling rate equates to the PRF of the Doppler unit. If thesampling rate is very low, the frequency of thereconstructed Doppler signal is in error andthe direction of flow is obtained wrongly. In a spectral display or flow image, this is called asan„aliasing‟artefact.

Effectofbeamangletoflow direction

The quality of a Doppler signal depends on the beam–vessel angle and, thus in particular,above 70° it degrades quite quickly . If the direction of an ultrasound beam is at 90° to thedirectionofthe flowingblood, then no Doppler signal is expected.

Effectof velocityscale

The scale should be chosen to accommodate the variety of velocities thought to be present.Toolowascalewouldcausealiasingandtoohighascaleresultsintheflowbeingdepictedasa few darkcolours in colour Dopplerimaging.

Unexpectedmachineartefacts

Doppler technology hasdevelopedrapidly andcanstillhave gremlinsinit.The operatormust thus check the performance and calibration of the instrument. This is mostly done in asituation where the flow pattern is considered to be well understood, like in a clearly seennormalblood vessel oraflowtest-object.

Factorsaffectingthepatient

It is necessary to have as complete information as possible of the patient‟s physiologicalstatus when undertaking blood flow studies, since many factors affect the cardiovascularsystem. Egs of such factors are exercise, heart rate, temperature, anxiety, posture, food,smoking and other drugs. Patient or vessel movement if movement leads to the samplevolume of a Continuous Wave or Pulsed Wave beam to interrogate a different region, thebloodflow signal will obviouslybealtered.

Flashartefact

Movement of the patient, an organ, or the transducer during Doppler imaging gives tissues avelocity relative tothe transducer and thusscattered ultrasoundisDoppler shifted; a largearea of the image is thus colour-coded for the duration of the movement. This artefact is moreseverewith power Dopplerimagingbecause ofitsincreased sensitivity.

Beamposition within thevessellumen

The Doppler signal found from a vessel depends on how the beam insonates the vessel. Theeffect is less marked if the beam is broader than the vessel. A narrow beam through the centreof a vessel, therefore, overemphasises the high velocities while a beam through the side of thevesseldetects lower velocities.

One-dimensionalscan

Bloodflowoftenfollowsinanunknowndirectioninspaceinrelationtothetransducer,likein the heart orat a vessel bifurcation. Detecting the flowfrom one direction only measuresthevelocitycomponent alongwith that of beam direction.

STUDIES

1) In 1990, John P. Newnham et al[53] studied the different Doppler velocity waveform ofumbilical artery and umbilical artery systolic to diastolic ratios were recorded at 18,24, 28, and 34 weeksgestation. A significant association was observed between uteroplacental systolic to diastolic ratios of umbilical arteryat 24 weeks gestation. Theythus, confirmed therole for Dopplersystolic to diastolic ratios in the evaluation ofhigh-risk pregnancies and also concluded that the umbilical artery Doppler studydonotsupportaroleftheiruseasprimaryscreeningtestsinlow-riskobstetricpopulations.
2) Patrick F. W. Chien[54] in 2000 studied uterine artery Doppler in pregnancies of lessthan 24 weeks for early prediction ofPre eclampsia and concluded that Uterine arteryDoppler flow velocity has limited diagnostic accuracy in predicting preeclampsia,intrauterine growthretardation and perinataldeath.

3) K. Mäkikallio A. Tekay P. Jouppila[10]in 2004 concluded that the vascular impedancedecreases and the volume blood flow increases at the spiral arterial level as early asbetween the 5th and the 7th weeks of gestation. During this period of gestation, theuterine and arcuate artery hemodynamics remains unchanged. On the other hand, inthe uterine and arcuate arteries, there is decrease in impedance and increase inabsolute velocities that are detected after the 8th week of gestation. This delaybetween the changes in the spiral and uterine arteriesrepresent the magnitude of theincrease of placental volume and spiral arterial involvement which is necessary toaffecttheuterine hemodynamics.

4) KadirGuzen et Al[55] in 2005-foundthat

- Inadequacy of endovascular trophoblast invasion in spiral arteries is an etiologicfactor in pre-eclampsia and the physiologic changes can be tracked in decidualand myometrial spiral arteries of normotensive cases, while in pre-eclampsiaespeciallymyometrial invasion is onlypartial

- Number of pathological findings in biopsy specimens taken from the placentalbedincreases with severityof pre-eclampsia.
- Secondaryplacentalinsufficiencydetectedduringthe Dopplerultrasonographyandabnormal placental bed biopsyfindings correlate.
- Thus, Doppler ultrasonography is not only a non-invasive method for evaluatingfetalstatusinpre-eclampticpregnancies,butitalsocorrelateswithpartialtrophoblasticinvasioninspiral arteries,whichcontributestothepathophysiologicmechanismsinvolved in pre-eclampsia

5) Ummu¨ Ozkaya et al[56] in 2006 in their study found that the GS/CRL ratio appeared tobesignificantlylowerinthecomplicatedpregnancygroup.GS–CRLdifference,GS/CRLratiocalculations,andyolksacdiametermeasurementaresimpleandreliableearlypregnancysonographicparametersthatcanbeaddedtoDopplerassessmentto predict obstetrical complications.

6) JhaVandanaetal[57]in2006concludedthatearlypregnancycomplicationslikethreatened abortion, missed abortion and anembryonic pregnancy are associated withmarked changes in uteroplacental circulation. This abnormal blood flow pattern mayincrease the oxidative stress on the early placental tissue and may subsequently impairplacentaldevelopment.

7) In 2006, Nagy and Gardo[32] compared spiral artery Doppler parameters between thetwo groups (each comprising of 30 patients) with complicated and uncomplicatedpregnancies 8–12 weeks gestation. They found that the peak systolic velocity and theresistanceindexandalsothepulsatileindexweresignificantlyhigherinthecomplicatedpregnancygroupascomparedtothenormalcontrolgroup.TheyadvocatedtheuseofspiralarteryDopplerinvestigationforthenoninvasiveassessment ofthe disturbances of trophoblast invasion in earlypregnancy

8) Deurlooetal[57]in2007foundintheirstudythatSpAflowvelocitiesdecreaseprogressivelywithadvancinggestationalage.ReferencerangeforSpAbloodvelocities are wide and early measurements of PI, RI or SD-ratios are not sensitiveenoughtopredictpreeclampsia,PIHorIUGRfetuses.TheyconcludedthatPregnancies complicated by PIH are likely to be caused by caused by a hyperdynamiccirculationinwomenwithpreexistenthypertensionandsuchpregnanciesare preceded bysignificantlylower spiral arteryimpedancevalues.

9) Ozkaya et al.[31] in 2007 carried out Doppler sonographic examination of uteroplacentalcirculation in 105 pregnant women with gestational agebetween 6–12 weeks with theaim to determine whether spectral Doppler measurements obtained from bilateraluterine, arcuate, radial, and spiral arteries in early gestation correlate with adversepregnancy outcome. They discovered that PI and RI values were significantly higherin right uterine artery in females with adverse pregnancy outcome than in women withnormal obstetric outcome. They found that PI and RI values were also higher in Spiralartery,butthedifferencewasnotstatisticallysignificant.TheyconcludedthattransvaginalultrasoundDopplerexamination(inearlypregnancy)candetecthemodynamicchangesinuteroplacentalcirculationassociatedwithsubsequentadversepregnancyoutcomes.

10) O Gomez et al[58] in 2008 concluded from their study that the mean UtA-PI shows aprogressive decrease until the late stages of pregnancy. Reference range for meanUtA-PI may have clinical value in screening for placenta-associated diseases in theearlystagesofpregnancy,andinevaluatingpatientswithpregnancy-inducedhypertensionand/or small-forgestational agefetusesduringthethird trimester.

11) Deurloo et al[59] in 2009 found in results that a continuous decrease of the mean PI inthe SA and UA with increasing gestational age. They concluded that uterine arteryDopplermeasurementsinearlypregnancyseemtoaccuratelyreflectperipheralresistance of SAs. They added that, trophoblastic invasion seems a continuous processin the first half of pregnancy, in which early UA bilateral notching is a physiologicevent.

12) Shaweez Faizi[60]in 2014 found in their study that among the various placental sites ofimplantation,laterallocationoftheplacentaisassociatedwithadverseantenataloutcomesl ikepre-eclampsia, antepartum hemorrhageandIUGR.

13) Ozhan et al[61] in 2015 concluded that the uterine artery systolic/diastolic ratios have apredictivevalueforearlypregnancylossandseemtobeusefulasamarker.Ontheotherhand,spiralart erychangescouldbedifficulttobeseeneasilysotheycannotbedeterminedby the parameters of spectral Doppler techniques. They suggested that uterine vascular bedalterations should be measured to understand the prognosis of early pregnancy loss during thefirsttrimester

14) According to duan J, et al[62]in 2017 studied the Validation of the 3D Power Dopplertechnique as a reliable indicator of utero-placental vascularisation and for a betterunderstanding of utero-placental physio-pathological mechanisms. They concludedthat if a high degree of correlation between the3D Power Doppler indices andplacental morphometry is confirmed, then the 3D Doppler angiography could have animportant role infuture strategies for placental vascular pathologyscreening anddiagnosis and advised for earlier screening (during the first trimester) for placentalvascularpathologiesifcouldbeestablishedandcorrespondingmedicalcareinstitut ed, which mayreducematernal and fetal morbidityandmortality

15) Rohit Bhoil et al[63] in 2019 found that transvaginal color Doppler sonography may beused to evaluate spiral arterial blood flow dynamics in early pregnancy (4–8 weeksgestation). Despite some technical limitations in assessing tiny vessels, like spiralarteries, and sonography were being a highly operator-dependent procedure, this is apromisingtechniqueinassessingspiralarterialhemodynamicchangesinearlypregnancy,e speciallyinhigh-risk patients".

16) Jha Vandana et al[57]found that vascular indices of missed abortion RI and PI havehigher values than threatened abortion RI and PI. Difference was significant for PIwith (P value of<0.01).They found that first trimester complications like threatenedabortion, missed abortion and anembryonic pregnancy are associated with markedchanges in uteroplacental circulation. This abnormal blood flow pattern may increasethe oxidative stress on the early placental tissue and subsequently impair placentaldevelopment.

17) Aseel Ghazi Rifat et al[64] in 2020 found in their study thatthere was a significantdifference in the means of PI, RI, and S/D ratio among the three groups comprising ofnormal intrauterine pregnancy, threatened abortion and missed abortion . However, PIwas the only parameter in doppler sonographic examination which was significantlyassociated with the outcome of pregnancy. They concluded from their study
that,uterinearteryDopplershouldbeintroducedastheroutinescreeningtestforidentifying the women who could have an adverse pregnancy outcome for its effectivemanagement.

18) Priyanka kumara et al[29] in 2020 found that uterine artery blood flow studies by transvaginalcolourdopplerUSGareusefulforpredictingtheoutcomeofthreatenedabortion in early pregnancy. Serum progesterone and Uterine artery RI both playsignificant role in evaluation of the outcome of threatened abortion in early pregnancyand confirmed that Uterine artery RI can be better tool than serum progesterone forpredictionof outcome of threatenedabortion in earlypregnancy.

MATERIALS ANDMETHODS

MATERIALANDMETHODS

StudyDesign:A Crosssectional study

Place of Study : Department of Obstetrics and Gynaecology, Santosh Medical College andHospitals,Ghaziabad

Duration of Study: OneyearfromJune2021-June2022

Sample Size : Assuming a pooled standard deviation of 2.4 units, the study would require asample size of 54 for each group (i.e. a total sample size of 108, assuming equal group sizes),to achieve a power of 80% and a level of significance of 5%(two sided), for detecting a truedifference in means between the test and the reference group of -1.299999999(i.e. 27.6-28.9)units.

Cases:55

Control: 58

Total:113

Sample Population : Antenatal patients presenting with first trimester bleeding before 10weeksofgestationattendingtheoutpatientdepartmentofdepartmentofObstetrics&Gynaecology,SantoshMedical CollegeandHospital,Ghaziabad.

It wasconducted on 55 patients presenting with complaints of bleeding per vaginum at 6-10weeks gestation in the OPD, IPD and emergency wards in the Department of Obstetrics andGynaecology.Controlgroupscomprisedofagematched58pregnantfemaleswithnocomplaints of bleedingper vaginum in thefirst trimester.

InclusionCriteria:

Thefollowingpatientswereincludedin the study

- Pregnantwomen (positiveurinarypregnancytest)
- SingletonPregnancy
- MaternalAge18 -35years

- Regularmenstrualcycleswithacyclebetween26and30days
- First trimester threatened abortion (vaginal bleeding/ spotting with or withoutabdominalpain)
- Unremarkablemedicalhistory
- Nohormonalcontraceptionuse
- Women who conceived spontaneously (as embryonic growth maybe different inpregnanciesfrom assisted reproductivetechniques)
- Nopregnancyorbreastfeedinginthe3monthsprecedingthe LMP
- Patientwhogaveinformedwrittenconsent

Exclusioncriteria:

Thefollowingpatientswere excludedfromthestudy:

- Patients who did not know or were not sure of their last menstrual period orHistoryof irregular menstrual cycle
- Patientswith a historyofmolar pregnancy
- Patientswith previous 2 ormoreconsecutivepregnancylosses
- Patientswithectopicpregnancy
- Patientswithuterinepathologylikemalformations orfibroids
- Patientswithavaginalorcervicallesionvisualizedclinicallythatcouldbethecauseofthe vaginal bleeding
- HistoryofanyMedical disorder likeHypertension, Diabetes orrenal disorders
- Intakeofanyanticoagulants oranyother drugs
- Addictionsliketobacco ordrugabuse
- Historyofhormonalcontraceptionorintrauterine contraceptivedeviceusage.
- PregnancyorbreastfeedingintheSmonthsprecedingtheLMP
- Congenitaluterineanomalies
- Pelvicbenign andmalignanttumorsdistortingtheuterinecavity
- Localcervicalandvaginallesionscausingbleeding
- Bleedingdisorders

Thediagnosticcriteriaforthreatenedmiscarriagewasbasedondocumentedfetalcardiac activity on ultrasound with a history of vaginal bleeding in the presence of aclosedcervixand gestational ageat 6 to 10weeks.

Ethics

Approval from the Ethical committee of the Santosh University was obtained beforeconducting the study. Informed written consent was taken from all participants beforerecruitmentandafterexplainingthepurposeand procedureof thestudy.

Ultrasound/Dopplerevaluation

All sonographic procedures were performed using a Voluson E6 ultrasound machineequipped with a real time 5-9 MHz endovaginal probe. Before the examination, thewomen were asked to empty their urinary bladder. After gently inserting the trans-vaginalprobe intothevagina,the uterusandadnexae wasscannedtoconfirmthepresence of intrauterine gestational sac. Uterine spiral arteries were assessed by triplexmode examination (gray scale image combined with color Doppler and a flow spectrumon the spectral wave). Spiral arteries just beneath the chorionic frondosum were assessedby powerDopplerimaging Flowvelocity waveforms.Systolic/diastolic(S/D)ratio,resistance (RI) and pulsatility indices (PI) was calculated automatically by using thesoftwareprogram in themachine.

Fig8: VOLUSONE6ULTRASOUNDMACHINE

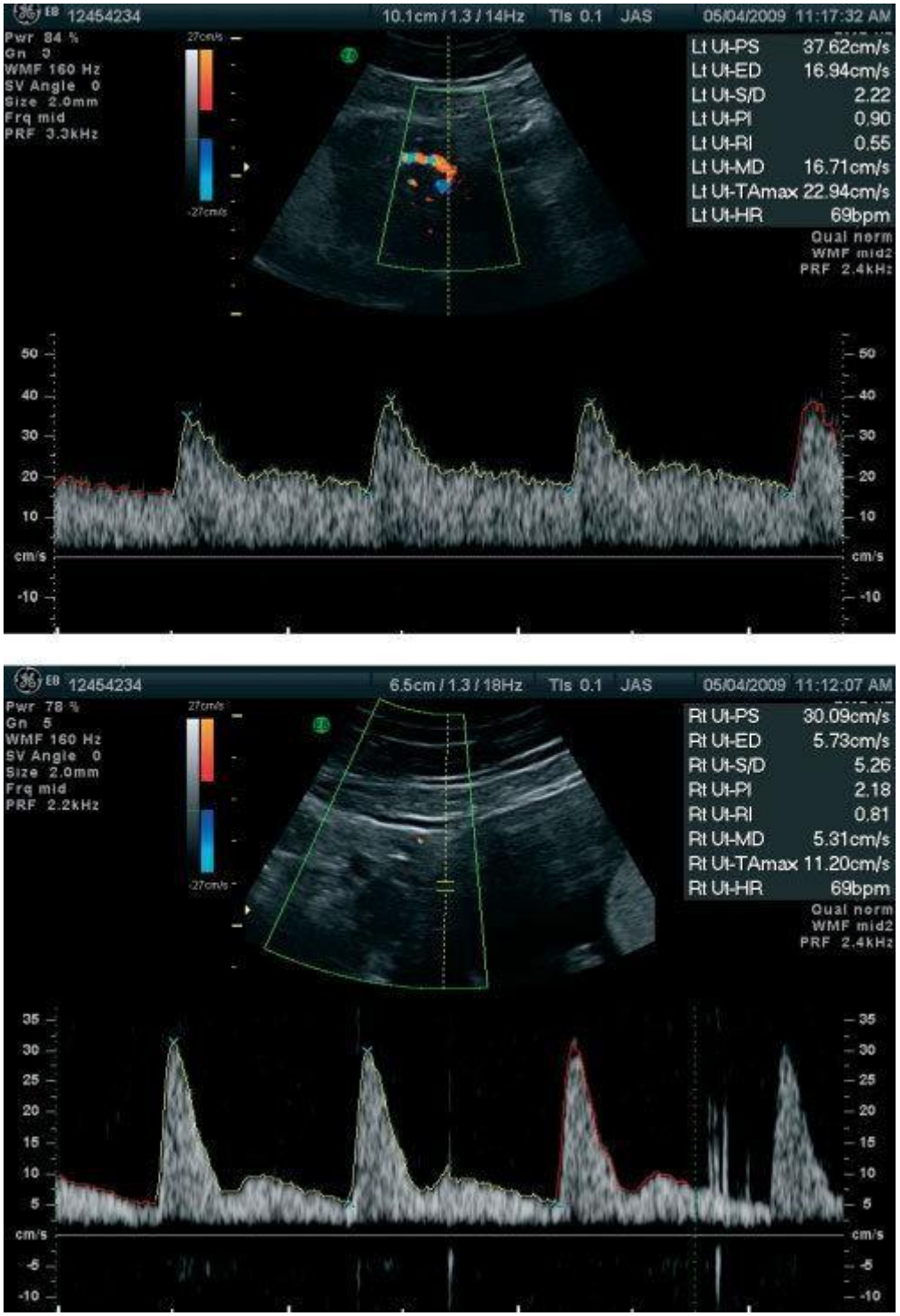


Fig9:DOPPLERFINDINGS INCASESOFNORMALINTRAUTERINEPREGNANCY

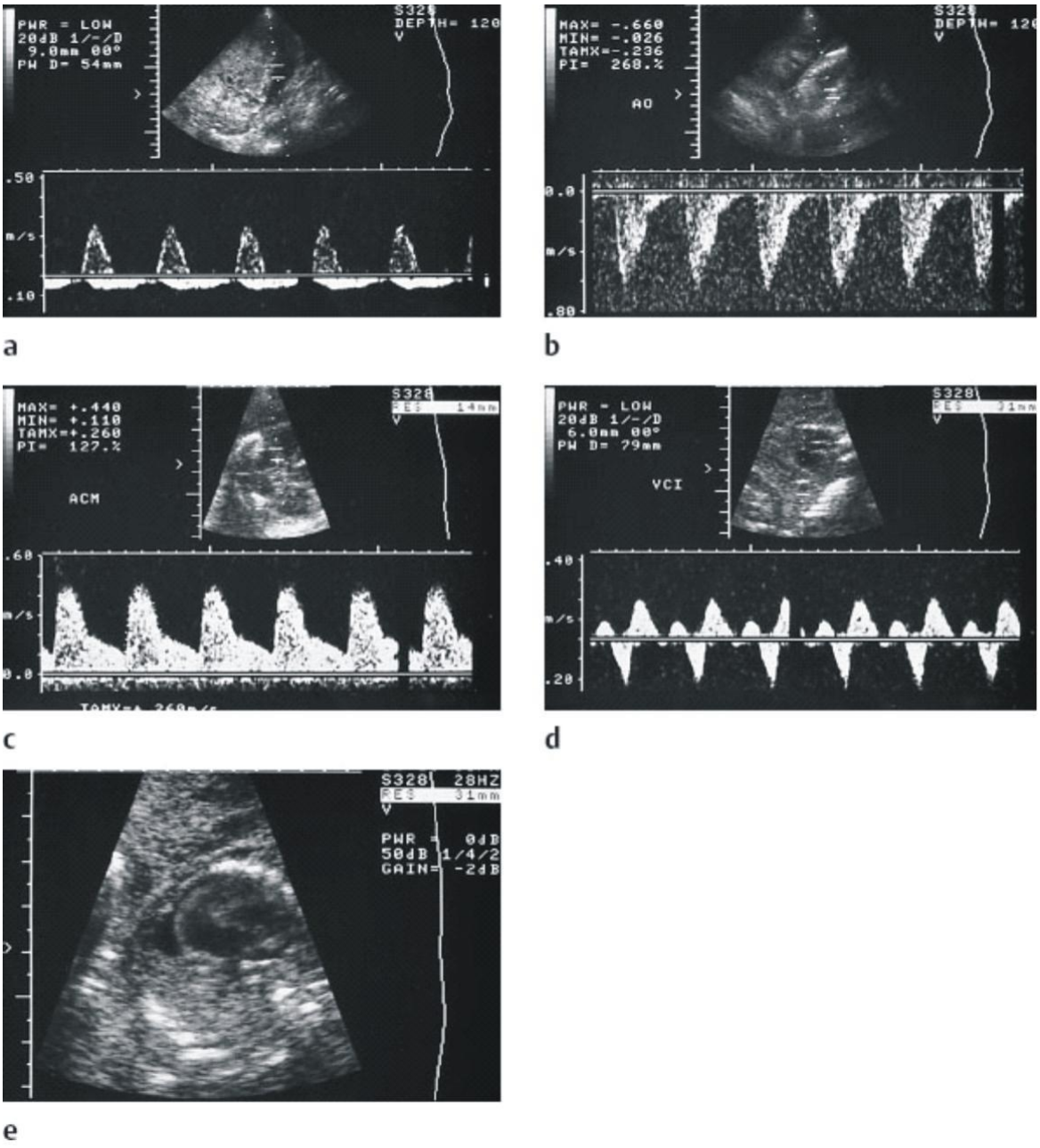


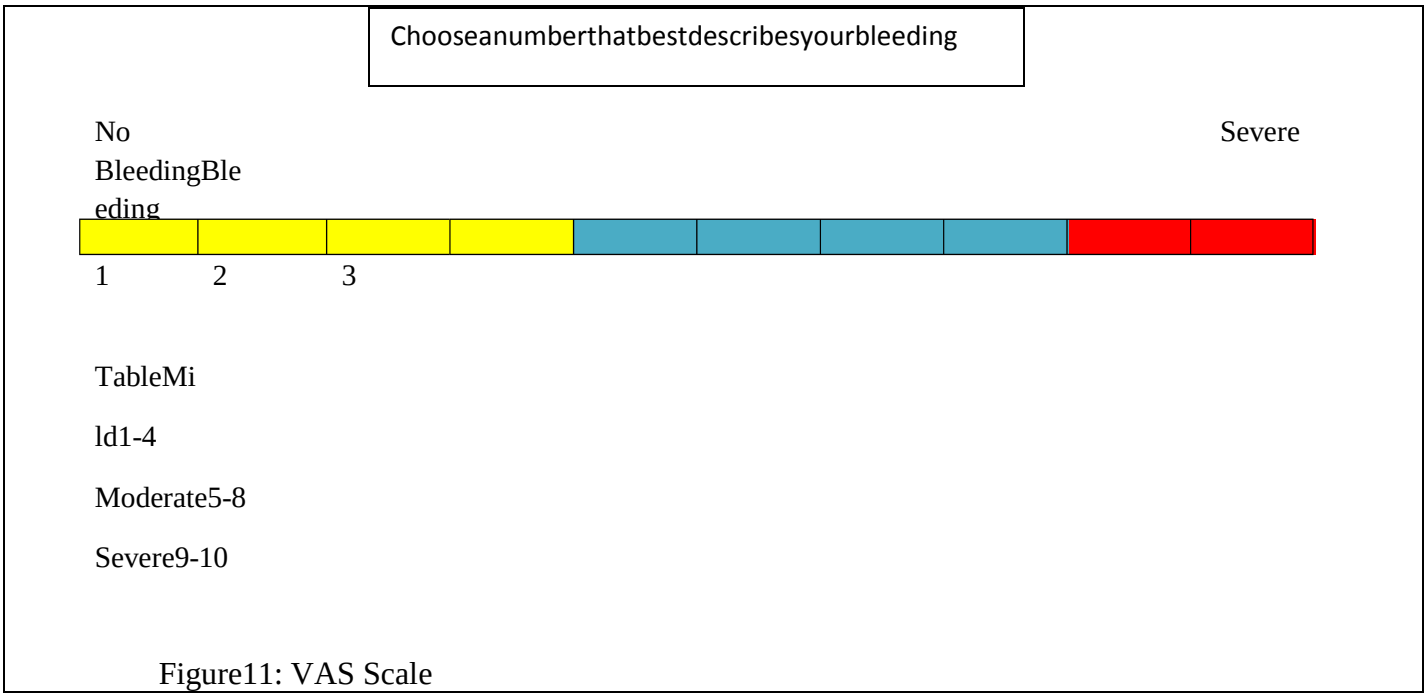
Fig 10: ABNORMAL DOPPLER FINDINGS IN THREATENED ABORTION IN FIRSTTRIMESTER

METHODS

Theeligiblesubjectsreportingwithpregnancylessthan10weekswiththreatenedabortion to the department of Obstetrics and Gynaecology were enrolled and controlgroup with gestational age matched women without history of bleeding were recruitedfor thestudy.Writteninformedconsentwastakenbefore enrolling the womeninstudy.

Adetailedhistorywastakenincludingage,parity,religion,occupation,literacy,history of coitus, duration of onset of bleeding, amount of blood loss and its associationwith pain. Clinical, systemic and gynecological examination was done for each patientand the amount of bleeding was assessed by Visual Analogue Scale(VAS) as there wasnoquantitativemethodtomeasureamountofbleeding.Routineandspecialinvestigations like ultrasound (pelvis/transvaginal) were done to confirm fetal viability,subchorionic hematomaand placentallocalization. Thepatients wereadmitted,treatedandcloselymonitoredandfolloweduptill20weeks.Allwomen bothstudy and control were prospectively followed till 20 weeks of pregnancyand their outcomes at 20 weeks was studied. Repeat Ultrasound and Doppler studieswereperformed at 20 weeks toknow theoutcomeat 20 weeksgestation.

VASSCALE



TableMild1-4

Moderate5-8

Severe9-10

Figure11: VAS Scale

Theoutcomeofpregnancyat20weekswascategorized as:

1) Viablepregnancy
2) Abortion
3) Lowlyingplacenta
4) Rebleeding
5) HDP
6) Leaking
7) GrowthLag

Statisticalanalysis

The maternal outcomes at 20 weeks among the groups were then compared. Categoricalvariableswerepresentedinnumberandpercentageandcontinuousvariableswerepresented as mean ± SD and median. Odds ratio with 95% confidence interval (CI) wascalculated formaternal outcome.Statisticaltests were applied asfollows-

1. Quantitativevariables werecomparedusingPairedttestbetweenthetwo groups.
2. QualitativevariableswerecorrelatedusingChi-Squaretest

A p value ofless than 0.05 (<0.05) was considered statistically significant. The datawasenteredinMSEXCELspreadsheetandanalysiswasdonebyusingSPSS21.0(trialversion).

OBSERVATIONSAN

D

RESULTS

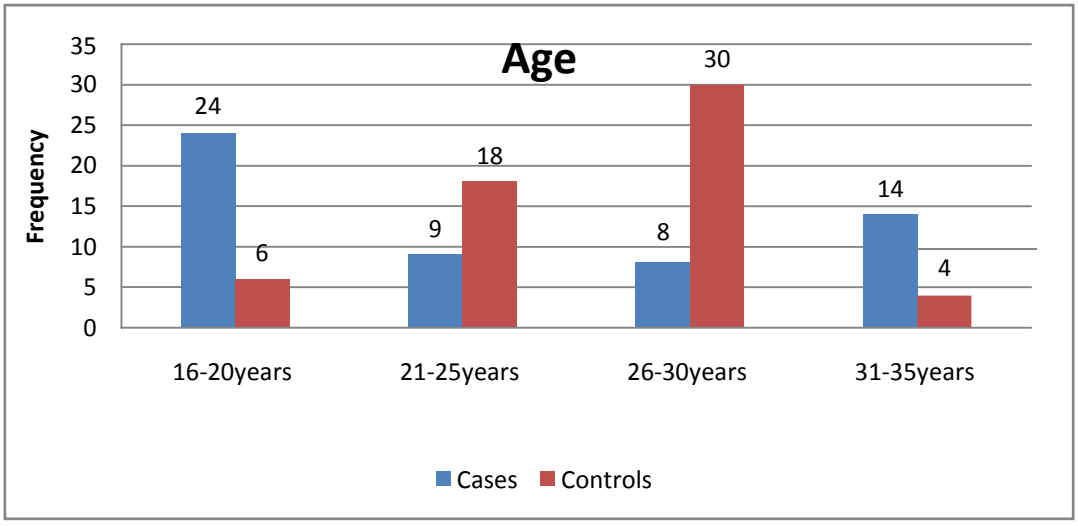
OBSERVATIONSANDRESULTS

The study was conducted in Santosh hospital on 113 subjects, with 55 women as cases whohad bleeding in early pregnancy with gestational age less than 10 weeks and 58 womenwithout any bleeding per vagina during pregnancy as control. Out of 55 cases, 16 cases werediagnosed as abortionon ultrasonography at or before 20 weeks and 12 control aborted at orbefore 20 weeks gestation ;therefore maternal outcome was compared in 39 cases and 46controls.

Table1:Agedistribution of subjectsinstudypopulation

Agegroup	Cases(n=55)		Controls(n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
16-20	24	43.64%	6	10.35%	**<0.0001**
21-25	9	16.36%	18	31.04%	
26-30	8	14.55%	30	51.72%	
31-35	14	25.45%	4	6.89%	
Total	55	100.0%	58	100.0%	
Mean ± SD	27.59 ± 3.08		27.96 ± 3.92		

ChartI:Agedistributionof subjectsinstudy population

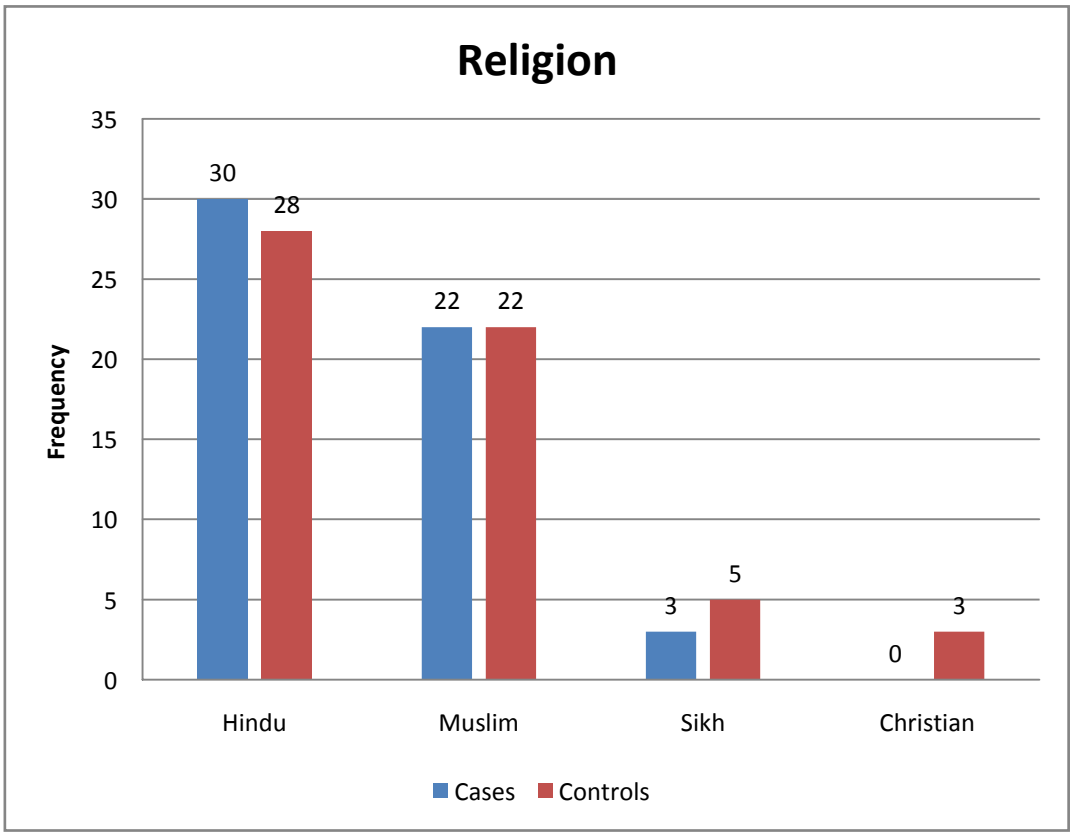


- In cases group the mean age± SD was 27.96+3.92 where as in control group themeanage± SD was27.59 ± 3.08
- In cases group 43.64%women fell in the age group of 16-20 years whereas incontrolgroup 10.35%women fellin theagegroupof 16-20years.
- Thetwogroupswerecomparableandstatisticallysignificant.

Table2:Distribution byreligionof subjectsinstudypopulation

Religion	Cases(n=55)		Controls(n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
Hindu	30	54.55	28	48.27	
Muslim	22	40	22	37.93	
Sikh	3	5.45	5	8.63	0.416
Christian	0	0	3	5.17	
Total	55	100	58	100	

ChartII:Distribution byreligionof subjectsinstudypopulation

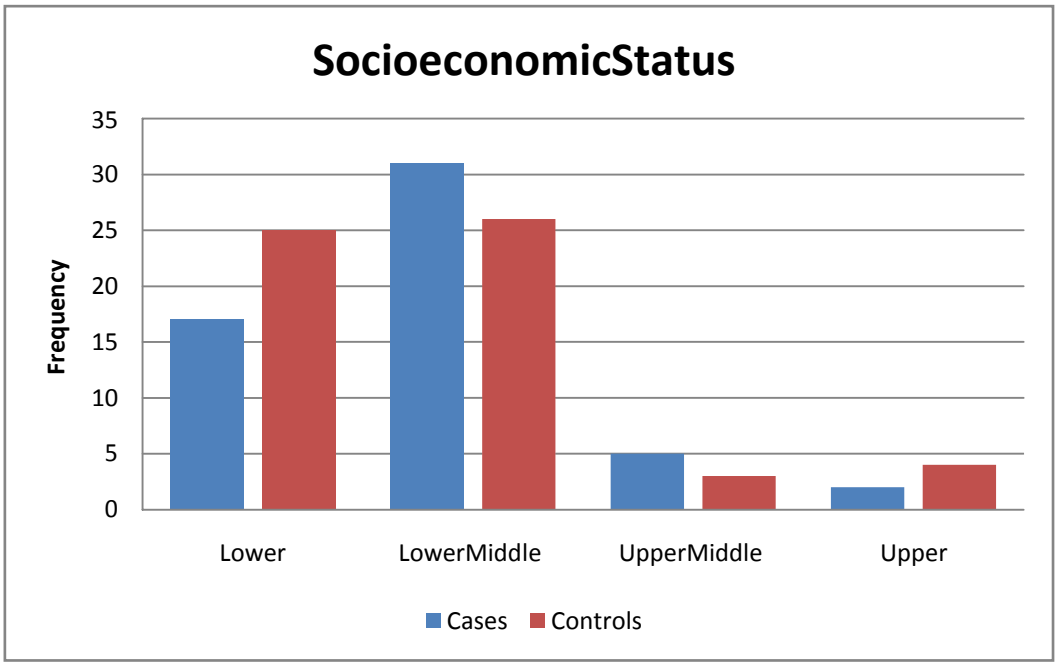


- Mostofthepatientsinboththegroupswerehindus.
- Incasesgroup54.55%andincontrol48.27%werehindusrespectively.
- Thetwogroupswerenotstatisticallysignificant.

Table3:Distribution ofSocioeconomicstatusofsubjectsinstudypopulation

Socioeconomic status	Cases(n=55)		Controls(n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
Lower	17	30.9	25	43.10	0.292
LowerMiddle	31	56.37	26	44.83	
UpperMiddle	5	9.09	3	5.18	
Upper	2	3.64	4	6.89	
Total	55	100	58	100	

ChartIII:Distribution of Socioeconomicstatusof subjectsinstudypopulation



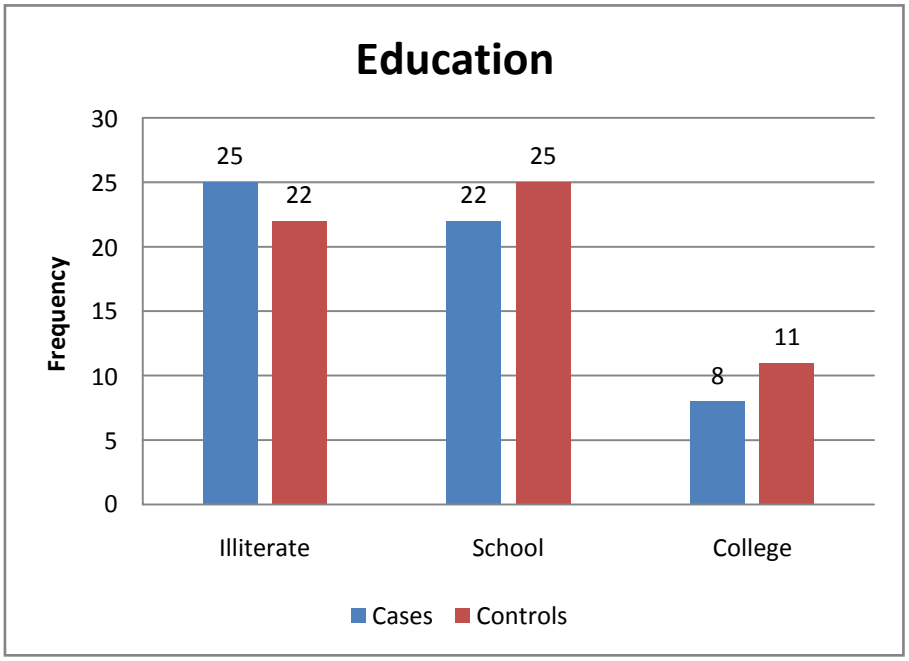
- Maximumnumberofwomeninbothgroupsbelongedtolowermiddlesocioeconomicgroup;56.37%incasesand44.83%incontrolrespectively.
- Therewereveryfewwomeninuppermiddlesocioeconomicgroupinboththegroups.
- Thedistributionbysocioeconomicstatusinbothgroupswerenotstatisticallysignif

icant.

Table4:Distribution byEducation of subjectsinstudypopulation

Literacy	Cases(n=55)		Controls(n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
Illiterate	25	45.45	22	37.94	0.719
School	22	40	25	43.10	
College	8	14.55	11	18.96	
Total	55	100	58	100	

ChartIV:Distributionof Educationof subjectsinstudypopulation

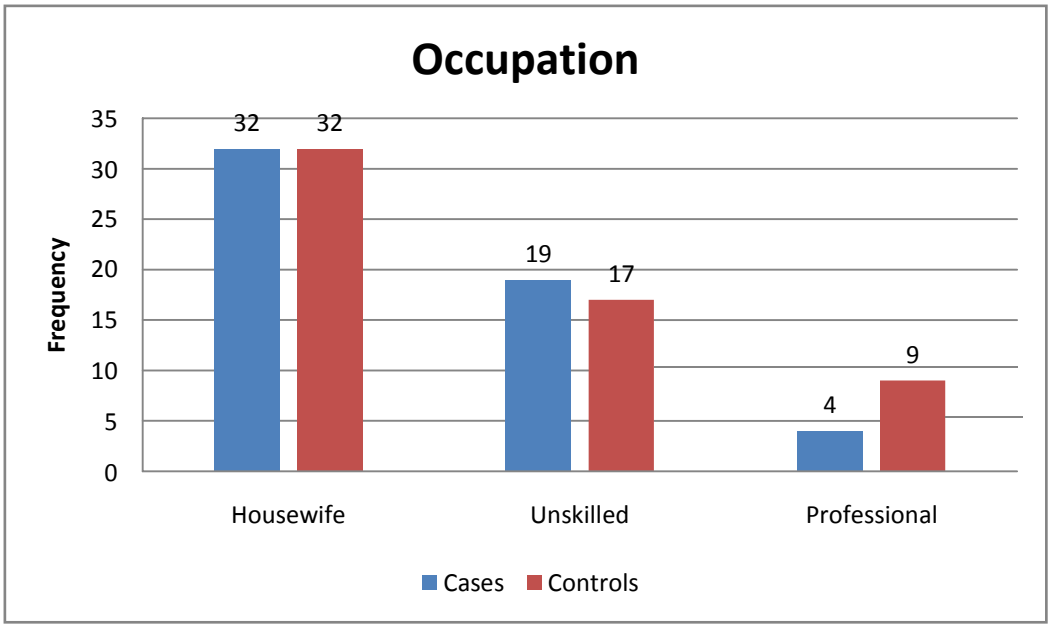


- Mostofthe womenin boththegroupswereilliterate,45.45%incases and 37.94%control.
- Inthe controlgroup40%whileincases43.10%hadschooleducation.
- Thedistributionofeducationinbothgroupswasnotstatisticallysignificant.

Table5:Distributionof Occupationalstatusofsubjectsinstudypopulation

Occupation	Cases(n=55)		Controls(n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
Housewife	32	58.18	32	55.17	0.448
Unskilled	19	34.55	17	29.31	
Professional	4	7.27	9	15.52	
Total	55	100	58	100	

ChartV:Occupation

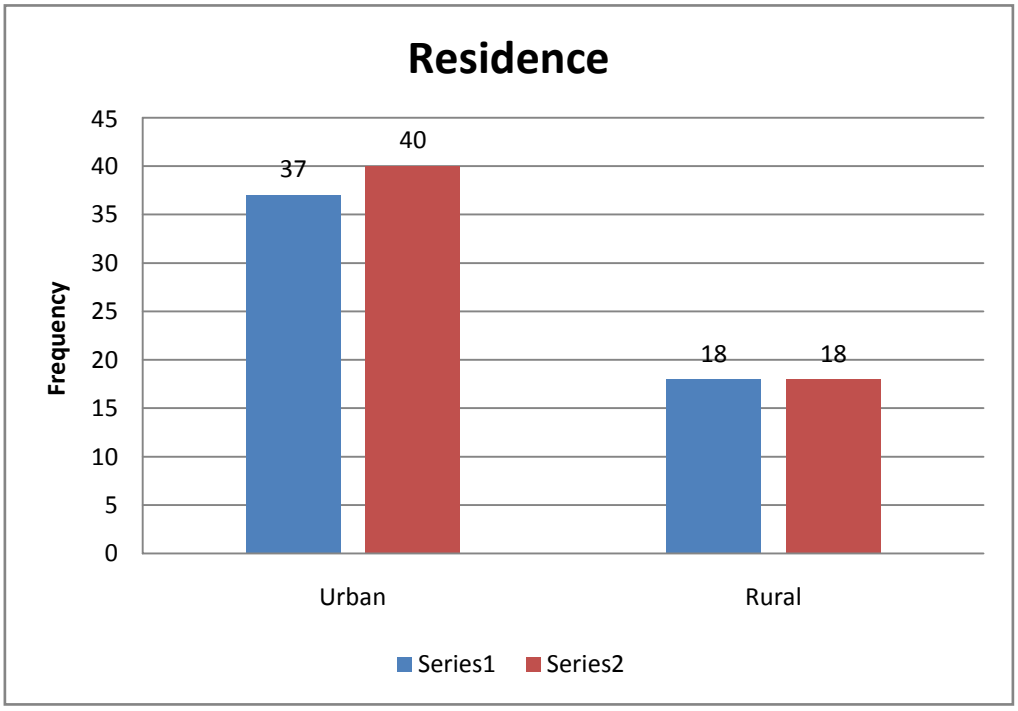


- Most of the women in cases and control groups were house wives with58.18%cases and55.17% controls respectively.
- Theproportion ofunskilledworkers were34.55%incasesand29.31%incontrol.
- Thedifferenceintheoccupationbetweenthetwogroupswasnotcomparable.

Table6:Residence

Residence	Cases(n=55)		Controls(n=58)		Pvalue
	Frequency	Percent	Frequency	Percent	
Urban	37	67.27	40	68.96	0.536
Rural	18	32.73	18	31.04	
Total	55	100	58	100	

ChartVI:Residence



- In the cases, 67.27% of the residents lived in urban areasand 32.73% livedinrural areas.
- In the control group, 68.96%of the residents lived in urban areas and31.04%lived in rural areas.
- Therewasnostatisticalsignificanceinboththegroups.

Table7:Sociodemographic data

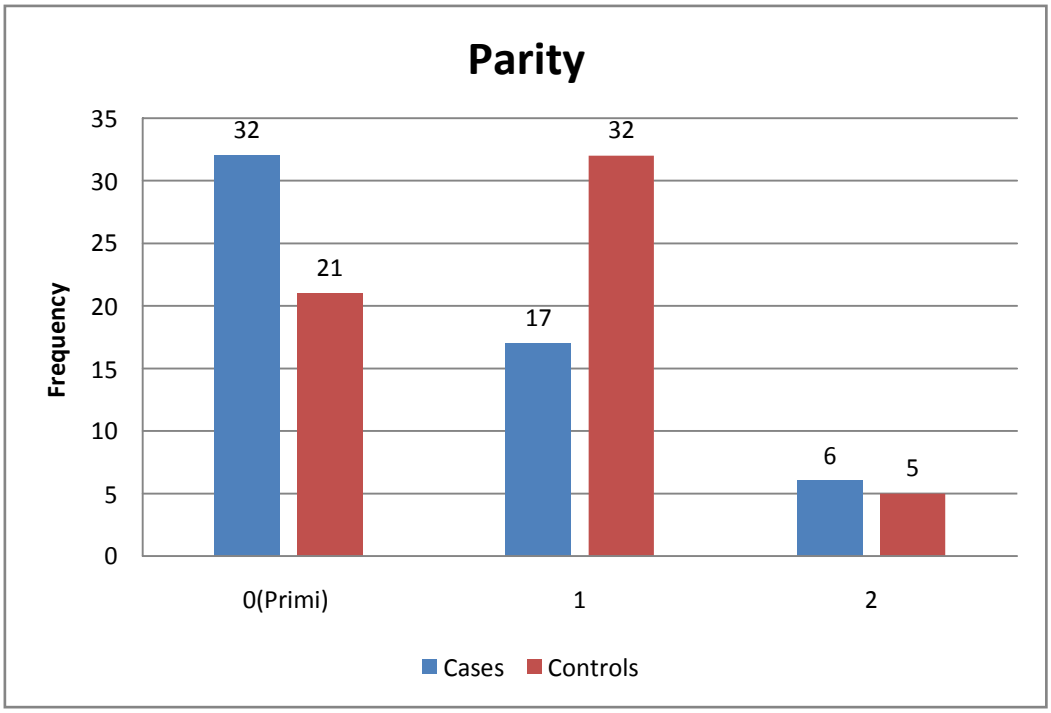
Variable		Cases(n=55)		Controls (n=58)		
1)AGEGROUP(in years)		Frequency	Percent	Frequency	Percent	
	16-20	24	43.63%	6	10.35%	<0.0001
	21-25	9	16.36%	18	31.04%	
	26-30	8	14.54%	30	51.72%	
	31-35	14	25.45%	4	6.89%	
	Total	55	100	58	100.0%	
	Mean ± SD	27.96 ± 3.92		27.59 ± 3.08		
2)RELIGION						
	Hindu	17	30.9	25	43.10	0.416 (NS)
	Muslim	31	56.37	26	44.83	
	Sikh	5	9.09	3	5.18	
	Christian	2	3.64	4	6.89	
3)SOCIO ECONOMIC STATUS						
	Lower	17	30.9	25	43.10	0.292 (NS)
	Lower Middle	31	56.37	26	44.83	
	Upper Middle	5	9.09	3	5.18	
	Upper	2	3.64	4	6.89	
4)EDUCATION						
	Illiterate	25	45.45	22	37.94	0.719 (NS)
	School	22	40	25	43.10	
	College	8	14.55	11	18.96	
5)OCCUPATION						
	Housewife	32	58.18	32	55.17	0.448 (NS)
	Unskilled	19	34.55	17	29.31	
	Professional	4	7.27	9	15.52	
6)RESIDENCE						
	Urban	37	67.27	40	68.96	0.536 (NS)
	Rural	18	32.73	18	31.04	

- Themeanageofthesubjectswhopresentedwiththreatenedabortionwas 27.96 ± 3.92andmeanageforsubjectswhopresentedwithuncomplicatedintrauterinepregnancywas27.59 3.08years (pvalue =0.0001).
- Therewasnostatisticalsignificanceinreligion,parity,socioeconomicstatus,literacy, residencyandoccupation betweenthe twogroups.

Table8:Parity

Parity	Cases(n=55)		Controls(n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
Primi (0)	32	58.18	21	36.21	0.574
1	17	30.91	32	55.17	
2	6	10.91	5	8.62	
Total	55	100	58	100	

CHARTVII: PARITY

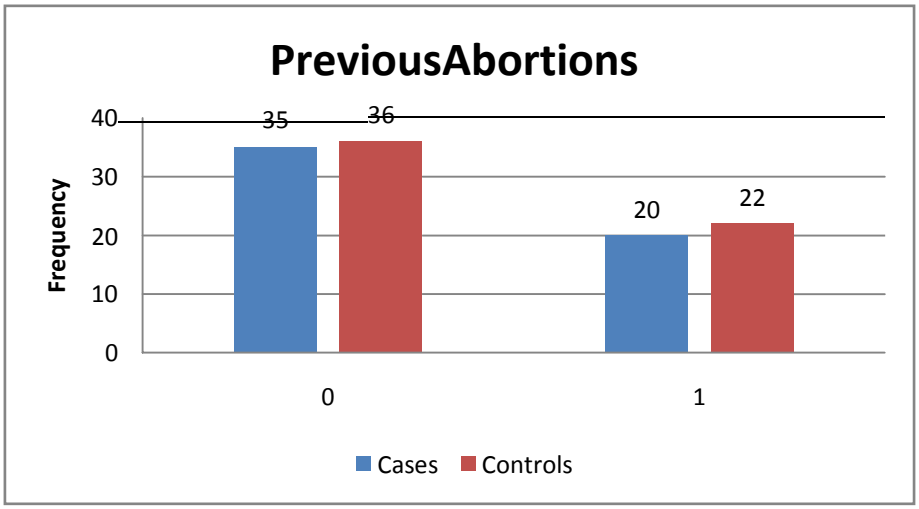


- Maximum number of women in cases group were with primigravida 58.18%followed bywith parityone30.91%.
- In control group also maximum number of women were with parity of one55.17%followed byprimigravida 36.21%.
- Therewereveryfew women with parityabovetwo in both thegroups.
- Both groupswerecomparablebutnotstatisticallysignificant.

Table9:PreviousAbortions

Previous Abortions	Cases(n=55)		Controls(n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
0	35	63.63	36	62.07	0.629
1	20	36.37	22	37.93	
Total	55	100	58	100	

ChartVIII: PreviousAbortions

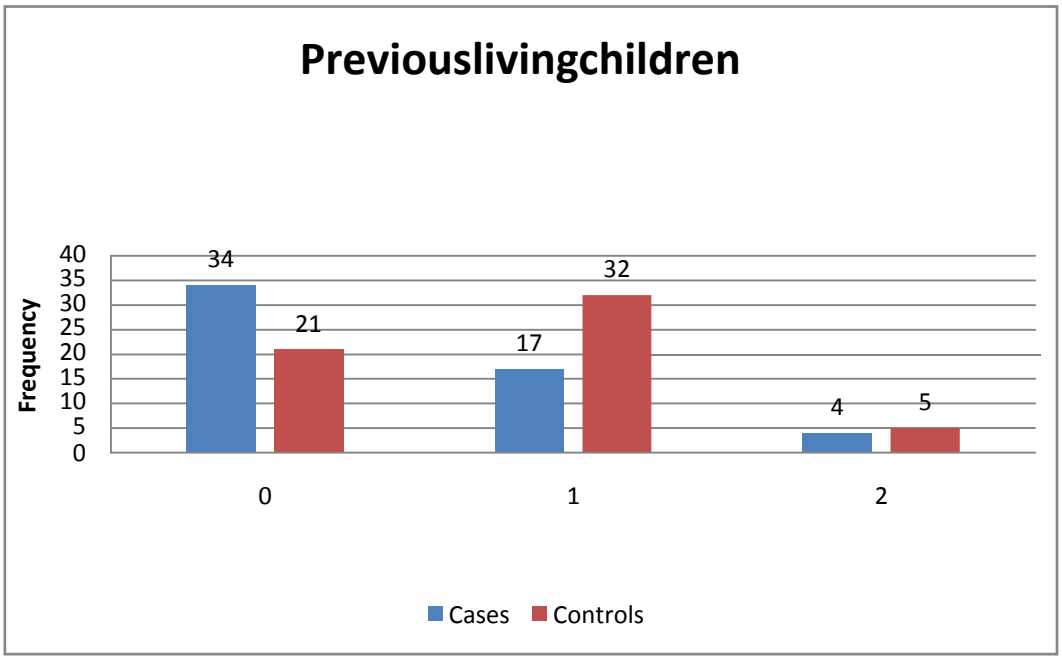


- Mostofthesubjectsinbothcasesand controlgrouphadnopreviousabortion.
- Inboth thegroups, 36.37%of cases and37.93%of control hadhistoryofoneabortion.
- Thegroups werecomparablebut not statisticallysignificant.

Table10:Previouslivingchildren

Previous Living Children	Cases(n=55)		Controls(n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
0	34	61.82	21	36.21	0.354
1	17	30.91	32	55.17	
2	4	7.27	5	8.62	
Total	55	100	58	100	

CHARTIX: Previouslivingchildren



- Inthecasesmajority(61.82%)hadnolivingissueswhile30.91%hadonelivechild.
- Incontrolsmajority55.17%hadonelivechildwhile36.21%

  hadnol

  ivingissues.
- Therewasnostatisticalsignificance inthenumberoflivingchildreninboththegroups.

Table11:Symptomsatpresentation

Symptom	Cases(n=55)		Controls(n=58)	
	Frequency	Percent	Frequency	Percent
Cramps	31	56.36	19	32.75
Backache	21	38.18	12	20.68
Fever	7	12.72	6	10.34
Vomiting	13	23.63	6	10.34
Bleeding	55	100	0	0

- **Majority of patient**s in the cases presented with cramps 56.36% followed bybackache38.18%
- **Majority of patient**s in the control group presented with cramps 32.75% followed bybackache20.68%

Table12:Period of gestationatbleedingpervaginum

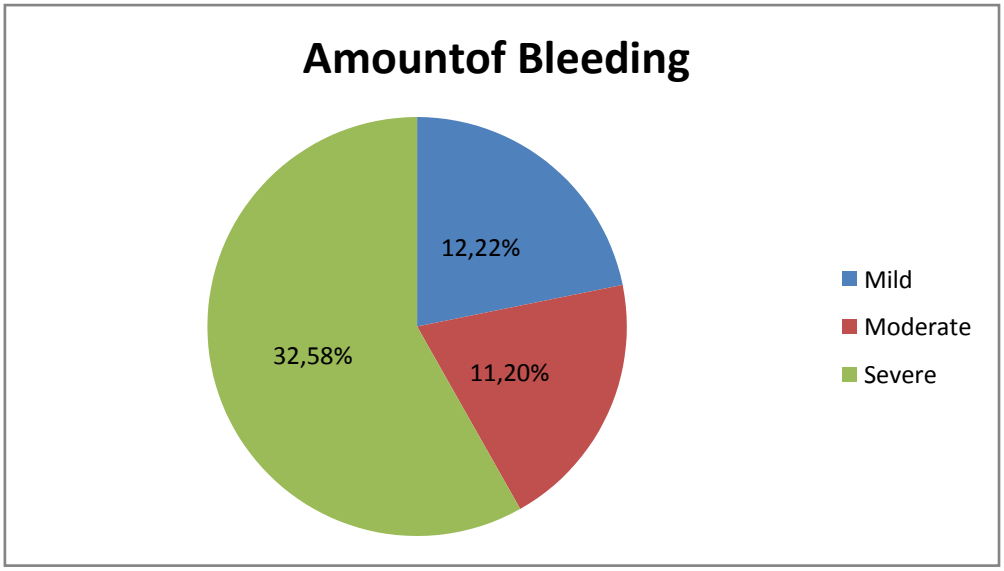
Period ofGestation (weeks)	Cases(n=55)	
	Frequency	Percent
5-8	25	45.45
8-10	30	54.55
Total	55	100
Mean±SD	7.81 ±1.17	
Minimum	6weeks	
Maximum	10weeks2days	

- Ofthe55womenwhopresentedwithbleedingpervaginum;54.55%presentedbetween8to 10weeksofgestationand45.45%presentedbetween5to8weeksofgestation.
- MeanPOGforpatientspresentingwithbleedingPVis7.81±1.17

Table13:Amountofbleedingatpresentationonthebasis ofVASscaleinthecases

Amount ofBleeding	Cases	
	Frequency	Percent
Mild(1-4)	12	21.82
Moderate(5-8)	11	20
Severe(9-10)	32	58.18
Total	55	100

CHARTX:AmountofbleedingatpresentationonthebasisofVASscaleinthecases



- Majority of patients complained of severe bleeding (58.18%) followed by 21.82%withmild bleeding

Table14:Historyofcoitus orblunttrauma

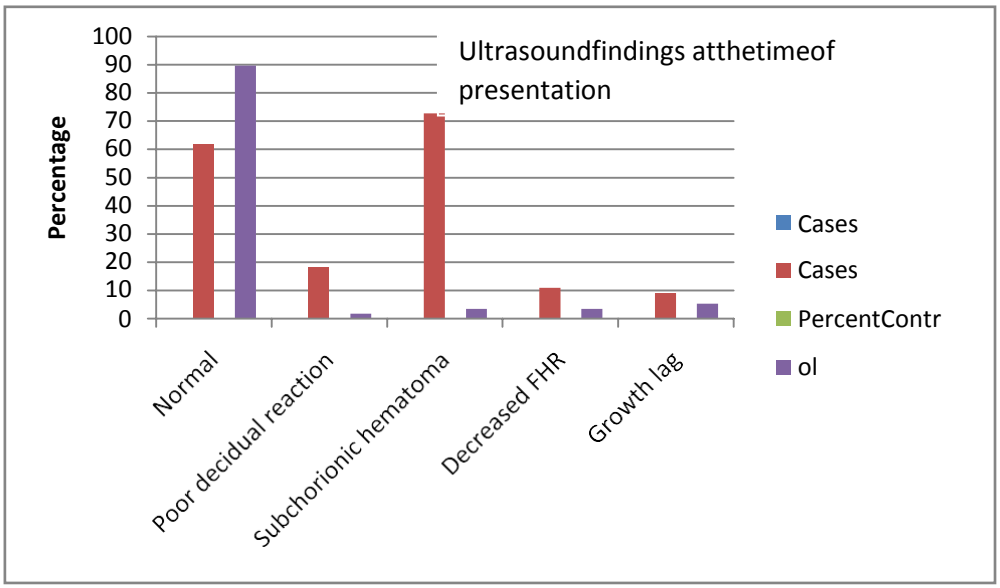
Historyof coitus orTraum a	Cases(n=55)		Controls(n=58)	
	Frequency	Percent	Frequency	Percent
Absent	46	83.64	51	87.93
Present	9	16.36	7	12.07
Total	55	100	58	100

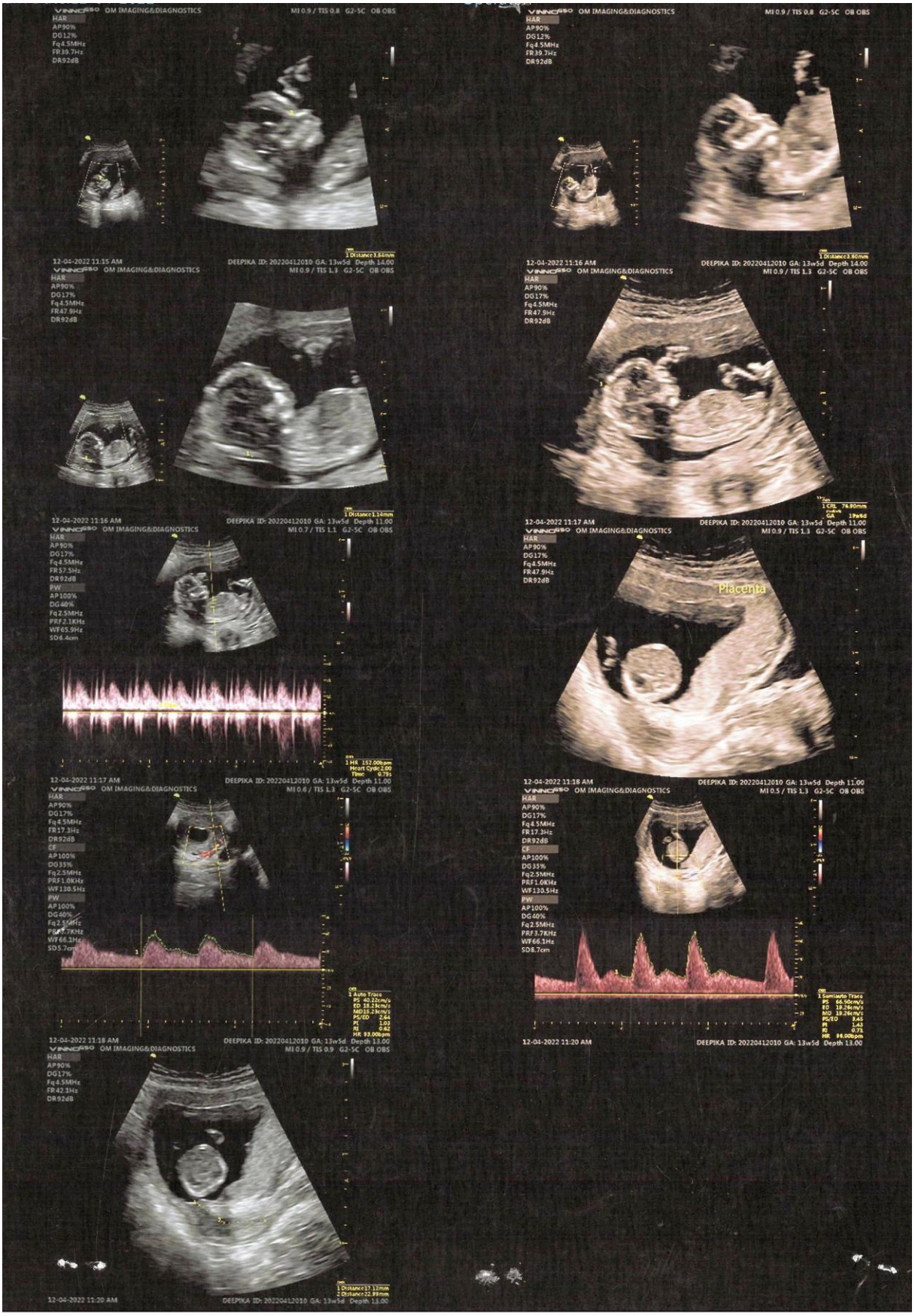
- 83.64%of cases and87.93% had no historyof coitus or trauma

Table15:Ultrasoundfindingsatthetimeofpresentation*

Ultrasound findings	Cases(n=55)		Control (n=58)		pvalue
	Frequency	Percent	Frequency	Percent	
Normal	34	61.82	52	89.65	0.0005
Poordecidual reaction	10	18.18	1	1.72	0.0032
Subchorionic hematoma	40	72.72	2	3.44	<0.0001
Decreased FHR	6	10.90	2	3.44	0.12
Growthlag	5	9.09	3	5.17	0.42

CHARTXI: Ultrasoundfindingsatthetimeofpresentation


Ultrasoundfindings atthetimeof presentation
Percentage
100
90
80
70
60
50
40
30
20
10
0
Normal
Poor decidual reaction
Subchorionic hematoma
Decreased FHR
Growth lag
Cases
Cases
PercentContr
ol



DopplerindicesinFirstTrimester

- Majorityofcases(61.82%)andcontrol(89.65%)hadnormalultrasoundfindings. Boththe groupswerestatisticallysignificant.
- 18.18%ofcasesand1.72%ofcontrolhadpoordecidualreaction.Boththegroupswerecomparable.
- 72.72%ofcasesand3.44%of controlhadsubchorionichematomaintheirultrasoundfindings. Their differencewas statisticallysignificant.
- 10.90%ofcasesand3.44%ofcontrolhaddecreasedFHRrecordsinultrasound.Thegroupswerecomparablebut not statisticallysignificant.
- 9.09%ofcasesand5.17%ofcontrolhadgrowthlag.Thetwogroupswerecomparablebut not statisticallysignificant.

Table16:Dopplerfindings ofultrasound atthetimeof presentationof spiralartery

DOPPLER	Cases	Control	
	Mean	Mean	Pvalue
PILeft Spiral Artery	0.902±0.08	0.707±0.05	<**0.0001**
PIRight Spiral Artery	0.884±0.10	0.694±0.06	<**0.0001**
RILeft Spiral Artery	0.788±0.09	0.504±0.02	<**0.0001**
RIRight SpiralArtery	0.8±0.09	0.502±0.02	<**0.0001**
SDRatio Left SpiralArtery	2.15±0.05	2.13±0.05	0.77
SD RatioRight Spiral Artery	2.22±0.05	2.18±0.04	0.68

- ThemeanPIofleftspiralarteryofcaseswas0.902±0.08and0.707±0.05respectively.Thegro

upswerestatisticallysignificant.

- ThemeanPIofrightspiralarteryofcaseswas0.884±0.10and0.694±0.06respectively.Thegroupswerestatisticallysignificant.

- ThemeanRIofleftspiralarteryofcaseswas0.788±0.09and0.504±0.02respectively.Thegroupswerestatisticallysignificant.
- ThemeanRI ofrightspiralarteryofcaseswas0.8±0.09and0.502±0.02respectively. Thegroups werestatisticallysignificant.
- ThemeanS/Dratios ofleftspiralarteryofcaseswas2.15±0.05and2.13±0.05respectively.Thegroupswerenot statisticallysignificant.
- ThemeanS/Dratiosofrightspiralarteryofcaseswas2.22±0.05and2.18±0.04respectively.Thegroupswerenot statisticallysignificant.

Table 17: Association of Amount of bleeding at presentation with Doppler studies at thetimeofpresentation

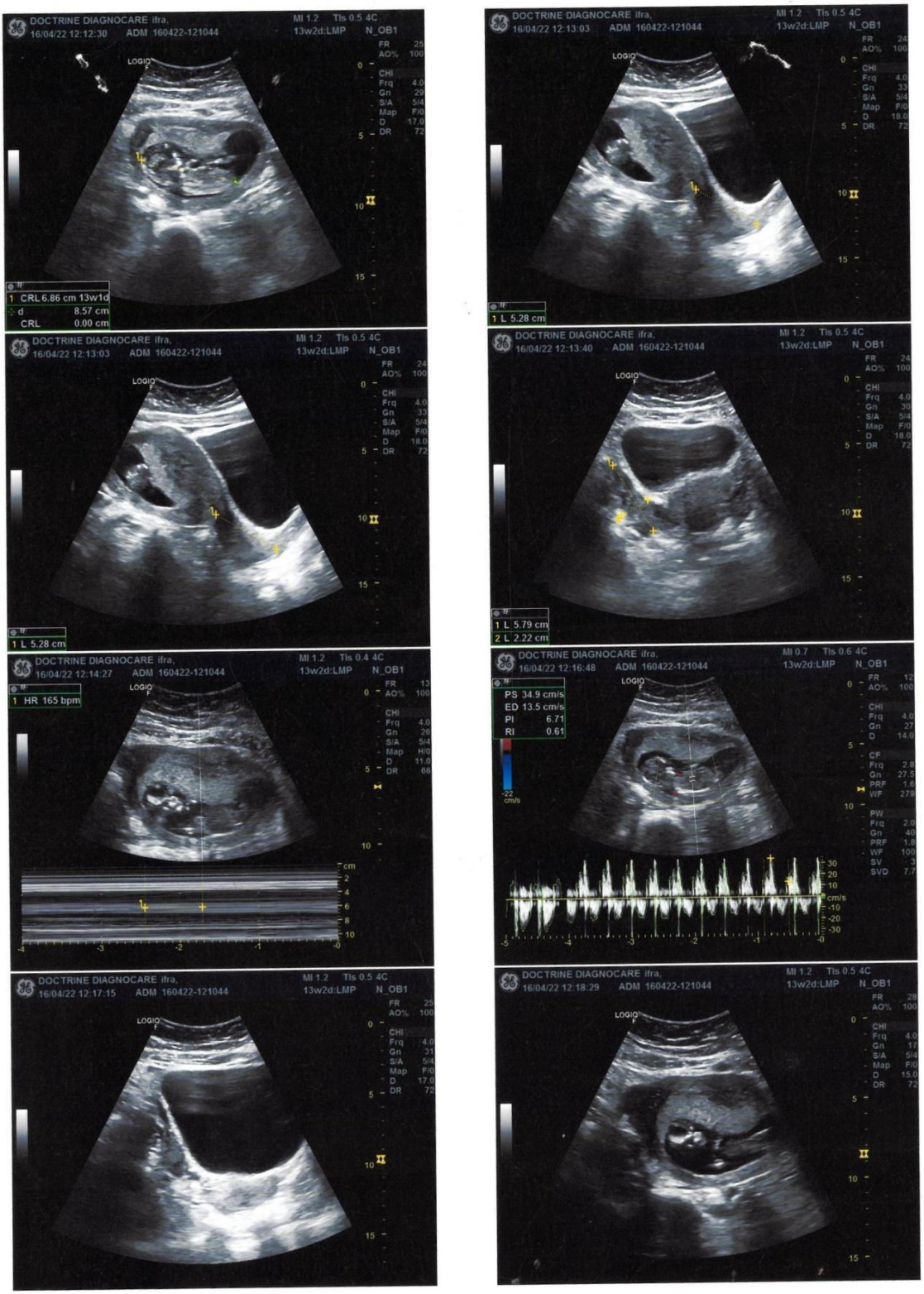
Amount ofBleeding	Cases		Doppler Studies		
	Frequency	Percent	MeanPI	MeanRI	S/DRatio
Mild(1-4)	24	43.64	0.74	0.48	1.4
Moderate(5-8)	11	20	0.82	0.52	1.6
Severe(9-10)	20	36.36	0.94	0.58	1.4
Total	55	100			

- ThemeanPI andRIvalue wasincreasedinpatientswithseverebleedingascomparedwithmild bleeding. S/D Ratio did not show anyrelation.

Table18:Dopplerindices of Uterineartery atthetimeof presentation

Doppler	Cases	Control	Pvalue
	Mean+S.D	Mean+S.D	
LtUterine ArteryPI	2.6±0.4	2.2±0.3	<0.0001
RtUterine ArteryPI	2.8±0.5	2.1±0.4	<0.0001
LtUterine ArteryRI	0.8±0.1	0.7±0.1	<0.0001
RtUterine ArteryRI	0.82±0.1	0.73±0.2	0.0033
Lt UterineArteryS/D Ratio	5.8±2.2	5.8±2.4	1.0
RtUterine Artery S/DRatio	5.88±2.1	5.91±2	0.94

- ThemeanPIofleftuterinearteryofcaseswas2.6±0.4andthatofcontrolwas2.2±0.3.Thegroups werestatisticallysignificant.
- ThemeanPIofrightuterinearteryofcaseswas2.8±0.5andthatofcontrolwas2.1±0.4.Thegro ups werestatisticallysignificant
- ThemeanRIofleftuterinearteryofcaseswas0.8±0.1andthatofcontrolwas0.7±0.1.Thegrou ps werestatisticallysignificant.
- ThemeanRIofrightuterinearteryofcaseswas0.82±0.1andthatofcontrolwas0.73±0.2.Theg roups werestatisticallysignificant.
- ThemeanS/Dratiosofleftuterinearteryofcaseswas5.8±2.2andthatofcontrolwas5.8±2.4. Thegroupswerenot statisticallysignificant.
- ThemeanS/Dratiosofrightuterinearteryofcaseswas5.88±2.1andthatofcontrolwas5.91±2. Thegroupswerenot statisticallysignificant.



DopplerindicesinFirstTrimester

Table19:Outcomeofpregnancyat20weeks

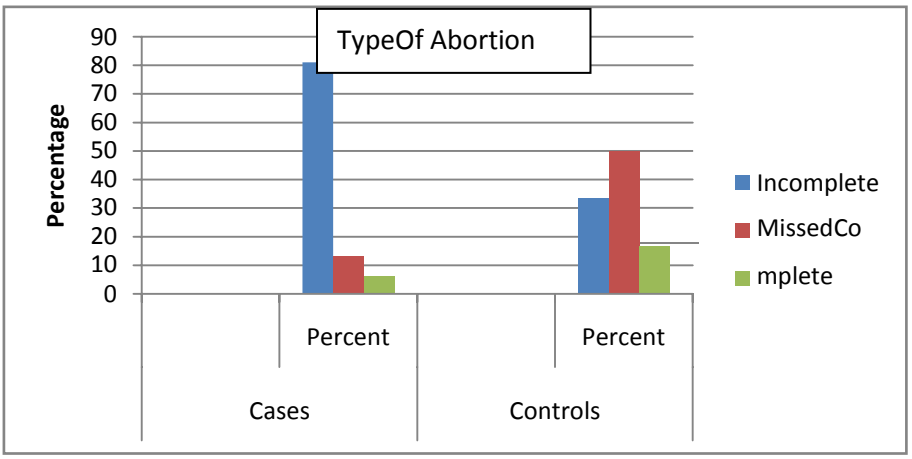
	Cases		Controls		Pvalue
	Frequency	Percent	Frequency	Percent	
Viable Pregnancy	39	70.91	46	79.31	0.30
Abortion	16	29.09	12	20.69	0.30

- Among the cases majority (70.91%) had a viable pregnancy when followed them at20weeks. Also, among the controls majority (79.31%) had a viable pregnancy at 20weeks.
- Boththegroupswerenot comparable.

Table20:Typeof Abortion

Typeof abortion	Cases		Controls		Pvalue
	Frequency	Percent	Frequency	Percent	
Incomplete	13	81	4	33.33	0.01
Missed	2	13	6	50	0.03
Complete	1	6	2	16.67	0.37
Total	16	100	12	100	

CHARTXII:TypeOfAbortion



- Amongthecaseswhoaborted,majorityofpatientswhopresentedwithincompleteabortion81%followed by13%presentedwith missedabortion.
- Amongthecontrolwhoaborted50%presentedwithmissedabortionfollowedby33.33%with incompleteabortion

Table21:Relation of abortion withmeanDopplerindicesof spiralartery

DopplerIndices	Totalnumberof abortions		pvalue
	Casesn=16	Controln=12	
MeanRI	0.59±0.04	0.92±0.02	<0.0001
MeanPI	0.48±0.03	0.82±0.01	<0.0001
S/DRatio	1.9±0.03	1.8±0.02	0.3275

- The mean RI among the cases who aborted was found to be 0.59±0.04 while incontrols the mean was found to be0.92±0.02. The groups were statisticallysignificant.
- The mean PI among the cases who aborted was found to be 0.48±0.03 while incontrols the mean was found to be 0.82±0.01.The groups were statisticallysignificant.
- The mean S/D Ratio among the cases who aborted was found to be 1.9±0.03 while incontrols the mean was found to be 1.8±0.02.The groups were not statisticallysignificant

Table22:Womenwithadversepregnancyoutcomeat20weeksinviablepregnancy

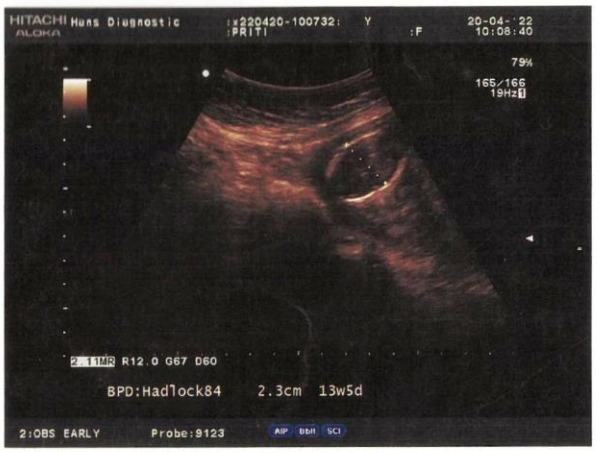
AdversePregnancy Outcome	Cases(n=39)		Controls(n=46)		
	Frequency	Percent	Frequency	Percent	Pvalue
Present	27	69.23	12	26.09	<0.0001
Absent	12	30.77	34	73.91	<0.0001

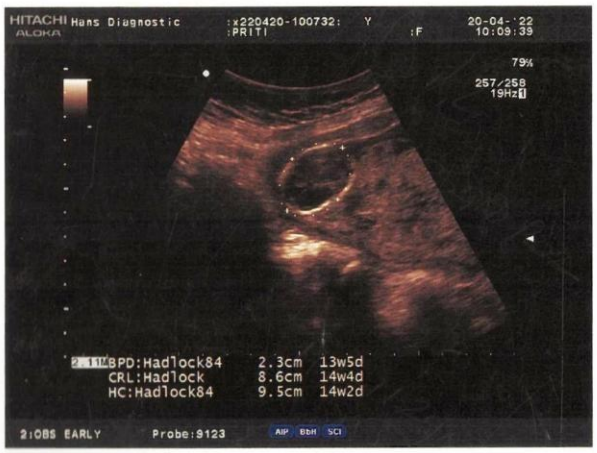
- Majorityofcases(69.23%)hadadversepregnancyoutcomewhile26.09%ofcontrolhadadversepregnancyoutcome. Thegroupswere statisticallysignificant.

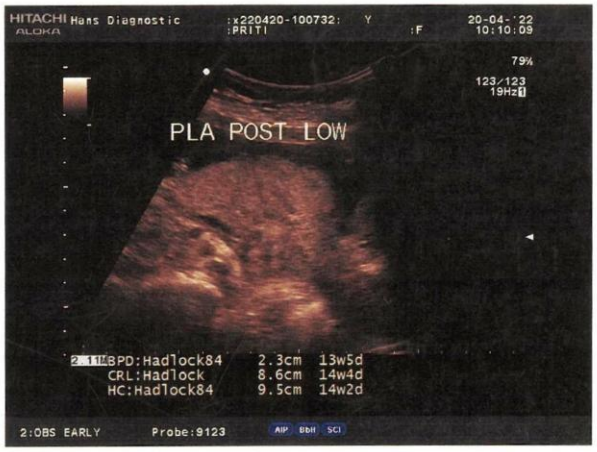
Table23:Distributionof Outcomeof pregnancy at20weeks*

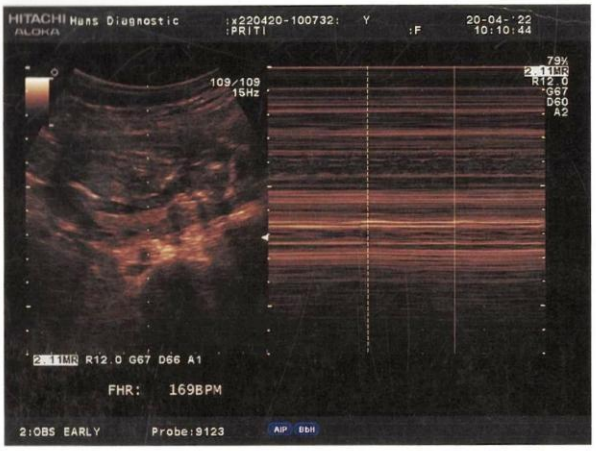
OUTCOME	CASE n=39		CONTROL n=46		ODDS RATIO	Pvalue
	FREQUENCY	PERCENT	FREQUENCY	PERCENT		
Uncomplicated Viable Pregnancy	12	30.77	31	67.39	0.215	0.0008
Subchorionic hematoma	24	61.54	2	4.35	35.2	<0.0001
RebleedingPV	18	46.15	0	0	0.8	<0.0001
PROM/Leaking	1	2.56	2	4.35	0.6	0.65
HDPat20weeks	4	10.26	6	13.04	0.76	0.69
Lowlying placenta	10	25.64	4	8.7	3.6	0.03
Growthlag	2	5.13	1	2.17	2.4	0.46

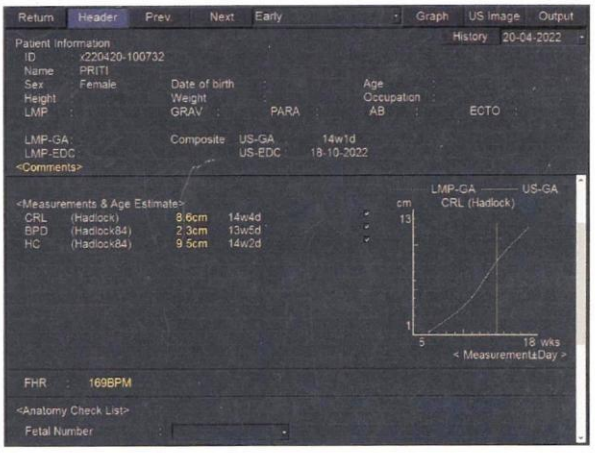
- Only 30.77% of cases had uncomplicated viable pregnancy while majority of control(67.39%)haduncomplicatedviablepregnancy.Thegroupswerefoundtobestatistica llysignificantwith odds ratio of 0.215.
- 61.54% of cases had sub chorionic hematoma while only 4.35 % of control had subchorionichematoma. Thegroups werestatisticallysignificantwith oddsratio of35.2.
- 46.15% of cases had rebleeding while none of the control had bleeding. The groupswerestatisticallysignificantwith odds ratio of 0.8.
- No statistical significance was seen in leaking , HDP, low lying placenta and growthlag.









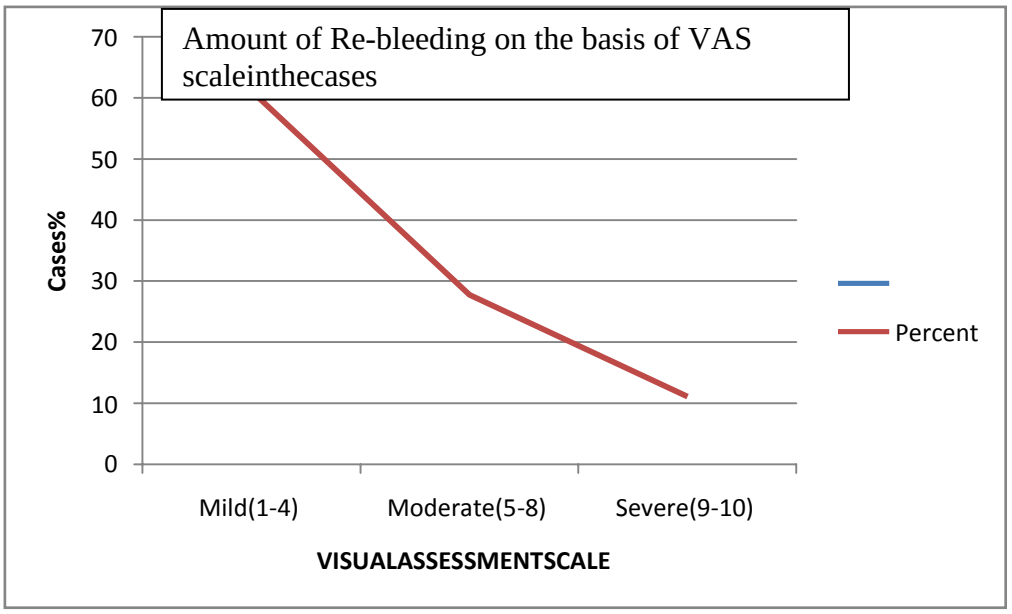


Ultrasoundsuggestiveoflowlyingplacenta

Table24:AmountofRe-bleedingonthebasisof VAS scaleinthecases

Amount ofBleeding	Cases(n=18)	
	Frequency	Percent
Mild(1-4)	11	61.11
Moderate(5-8)	5	27.78
Severe(9-10)	2	11.11
Total	18	100

CHARTXIII:Amountof Re-bleeding onthebasis of VASscaleinthecases



- 61.11%complained of mild re bleeding followed by 27.78% with moderate re-bleeding and only11.11%had severere-bleeding

Table 25 : Association of Amount of Re bleeding at presentation with mean Dopplerindicesat20 weeks

Amount ofBleeding	Casesn=18		Doppler Studies		
	Frequency	Percent	MeanPI	MeanRI	S/DRatio
Mild(1-4)	11	61.11	0.46	0.38	1.6
Moderate(5-8)	5	27.78	0.48	0.41	2.2
Severe(9-10)	2	11.11	0.58	0.47	2.3
Total	18	100			

- The mean PI and RI and S/D ratio was increased in patients with severe re-bleeding ascomparedwith mild re-bleeding.

Table26:Association ofSub chorionichematomawithpregnancyoutcome* at20weeks

Outcomeat 20weeks	Casesn=24		Controls n=2		
	Frequency	Percent	Frequency	Percent	Pvalue
Abortion	10	41.67	1	50	0.88
Normal Pregnancy	8	33.33	1	50	0.76
HDP	1	4.17	0	0	0.77
APH	5	20.83	0	0	0.48

- 41.67% of cases with subchorionic hematoma aborted at or before 20 weeks where as50% of control with sub chorionic hematoma aborted at or before 20 weeks. Thegroupswerenotstatisticallysignificant.
- 33.33% of cases with sub chorionic hematoma had normal pregnancy and 50% ofcontrolhadnormalpregnancyat20weeks.Thegroupswerenotstatisticallysignificant.
- Nostatistical significancewasseeninthese groupsforHDPandAPH.

Table27:AssociationofSubchorionichematoma(SCH)withmeanDopplerchangesat20 weeks

	SubChorionic Hematoma		Pvalue
DopplerStudies	Casesn=24	Controln=2	
Mean PI	0.59±0.04	0.48±0.03	0.0009
MeanRI	0.46±0.04	0.41±0.03	0.03
S/DRatio	1.9±0.04	1.8±0.03	0.09

- ThemeanPIincaseswithSCHwas0.59±0.04andincases0.48±0.03.Thegroupswerecompa rable and werestatisticallysignificant.
- ThemeanRIincaseswithSCHwas0.46±0.04andincases0.41±0.03.Thegroupswere comparable andwerestatisticallysignificant.
- ThemeanS/DRatioincaseswithSCHwas1.9±0.04andincases1.8±0.03.Thegroupswereco mparablebutwerenot statisticallysignificant.

Table28:ComparisionbetweenSpiralarteryinearlyfirsttrimesterandSpiralarteryat20weeks

DopplerIndices	Casesn=39		Controln=46	
	SpAatIst Trimester	SpAat20weeks	SpAatIst Trimester	SpAat20weeks
MeanRI	0.795±0.09	0.48±0.03	0.5±0.02	0.38±0.01
Mean PI	0.89±0.09	0.67±0.03	0.7±0.06	0.47±0.03
MeanS/DRatio	2.19±0.05	0.35±0.02	2.16±0.05	0.34±0.04

- TherewasadecreaseinRI,PIandS/Dratioof spiralarteryat 20weeksas comparedtofirst trimester in both cases andcontrol.

Table29:DopplerIndicesat20weeks

Variable		DopplerIndices		
1)Re bleeding		Mean PI	MeanRI	S/DRatio
	Mild(1-4)	0.46±0.03	0.38±0.04	1.6±0.03
	Moderate(5-8)	0.48±0.03	0.41±0.04	2.2±0.03
	Severe(9-10)	0.58±0.03	0.47±0.04	2.3±0.03
2)Subchorio nicHema to ma				
	Casesn=24	0.59±0.03	0.46±0.04	1.9±0.03
	Controln=2	0.48±0.03	0.41±0.04	1.8±0.03

- The mean PI , RI value and S/D ratio was increased in patients with severe re-bleeding as compared with mild bleeding. Doppler indices showed an increasing trendwithmoreseverityofamount of re-bleeding.
- The mean PI in cases with SCH was 0.59±0.04 and in cases 0.48±0.03. The groupswerecomparable and werestatisticallysignificant.
- The mean RI in cases with SCH was 0.46±0.04 and in cases 0.41±0.03. The groupswerecomparable and werestatisticallysignificant.
- The mean S/D Ratio in cases with SCH was 1.9±0.04 and in cases 1.8±0.03. Thegroupswerecomparablebut werenot statisticallysignificant.

DISCUSSION

DISCUSSION

Successful pregnancy depends upon the unimpeded to and fro transfer of nutrients, oxygenand wastes in-between the maternal and fetal compartments. The normal development of theuteroplacentalcirculationspaceisimportantinearlypregnancyforwhichsuccessfultrophoblasticinvasionofthematernaldecidua,myometriumandthebloodvesselsisrequired[63].

Doppler ultrasound is a non-invasive method for examining the uteropla cental circulationand has been reported to have a high predictive value for several obstetric events throughoutthe pregnancy. The ability of transvaginal Doppler ultrasound to demonstrate the blood flowpatterns even in the terminal uteroplacental circulation has given rise to much eagernessregardingthepredictionofearlyandlateobstetricalcomplications,particularlythoseassociatedwithdefectiveplacentation.Thedifferentbranchesoftheuterinecirculationcanbedifferentiatedbymeansofcolorandspectral Dopplerimaging.Theprobabilityofidentifyingtheuteroplacentalvascularchangesfromtheimplantationprocesstotheendofthe pregnancy could provide a perfect diagnostic tool for the clinical management of the earlypregnancies andits complications[56].

In the current study, in healthy gestation,we observed a consistent decrease of PI and RI inSpiral Artery from the first to the second trimester. Transformation of adrenergic sensitivehigh-resistance into adrenergic-insensitive low resistance Spiral Artery ensures unrestrictedblood flow into the placenta . During early gestation, interstitial and endovascular trophoblastcells invade into Spiral Artery, where they start to replace the muscular wall and endotheliumof these feeding vessels. Thus, diameters of Spiral Artery broaden and lose their ability torespond to vasoactive stimuli, allowing continuous increased low-velocity low resistancebloodflowintotheplacentalintervillousspaceandavoidingdamagetoplacentaltissue .Similarly,totalperipheralvascularresistancedecreases andmaternalcardiacoutputrises[6].

Uteroplacental circulation is the earliest to be affected in pregnancy with evident changesfromweek4onwards.TransvaginalDopplersonographyisanon-invasiveandwidelyavailable screening method for disorders of placental function that occur early in pregnancyandmaybeusedtopredictanumberofobstetriccomplicationsthatcanbelinkedtodefectiveplacentation and implantation[63].

The accurate time at which high oxidative maternal blood starts to flow into the intervillousspace ranges from 5 to 12 weeks of gestation and is stopped earlier by the formation ofendovasculartrophoblast„plugs"inthedistalsegmentoftheSpiralArtery.Thesetrophoblasticplugscreateahypoxicplacentalenvironmentthatguardsthefoetusfromoxidative stress and its damage . The debatable data about the time of onset of maternal bloodflowintotheplacentacouldpossiblybeexplainedbythelimitedultra-sonographicpossibilitieswhenattemptingtovisualizesmallvesselswithlowvelocity.Defectiveremodeling of Spiral Artery can result in a premature onset of maternal, high-flow and -oxidativebloodintotheplacenta,generatingmechanicalandbiochemicaltrophoblasticdamageandincreasedapoptosis.InPlacentalSyndromepregnancies,whenoxidativestressis not yet enough to influence the preservation of the conceptus, transformation of the SpiralArtery walls will occur partially in the center of the placental bed and is limited to thedecidual segments of the vessels. This leads to vessels with high resistance, diminishedperfusionand possiblyresultin thedevelopmentof clinical hypertensivedisordersor FGR[6].

Multiple openings are formed in the walls of the Spiral Arterywhich are in connection withthe intervillous space, depriving the more distal segments of Spiral Artery of blood flow andleading to local decidual necrosis in the peripheral parts of the placent. The onset of maternalblood flow into the placenta is initiated with unplugging of the Spiral Artery, which is moreextensive in the peripheral parts and leads to a local hyperoxic environment. Higher levels ofoxygen lead to oxidative stress and induce a down-regulation of angiogenic growth factorsandinhibit the invasive and proliferativeactivityofthetrophoblast.

K.MäkikallioA.TekayP.Jouppila[10]in2004concludedthatthevascularimpedancedecreases and the volume blood flow increases at the spiral arterial level as early as betweenthe 5th and the 7th weeks of gestation. During this period of gestation, the uterine and arcuateartery hemodynamics remains unchanged. On the other hand, in the uterine and arcuatearteries, there is decrease in impedance and increase in absolute velocities that are detectedafter the 8th week of gestation. This delay between the changes in the spiral and uterinearteriesrepresent the magnitude of the increase of placental volume and spiralarterialinvolvementwhich is necessaryto affect theuterinehemodynamics.

Ozkayaetal[56]in2007broughtoutDopplerultrasoundexaminationofuteroplacentalcirculationin

105pregnant women at6–12 weeksofgestation withtheaimto determine

whether spectral Doppler measurements obtained from bilateral uterine, arcuate, radial, andspiral arteries in early gestation correlate with adverse pregnancy outcome. They establishedthatPI andRI valuesofdopplerwere significantly higherintherightuterineartery infemales with adverse pregnancy outcomes than in women with normal obstetric outcome.Spiral artery PI and RI values were also higher, but were not statistically significant. Theyconcluded that transvaginal Doppler ultrasound examination (in early pregnancy) can detecthemodynamicchangesinuteroplacentalcirculationassociatedwithsubsequentadversepreg nancyoutcomes.

In 2006, Nagy and Gardo[32]compared spiral artery Doppler parameters between thetwogroups (each comprising of 30 patients) with complicated and uncomplicated pregnancies 8–12 weeks gestation. They found that the PSV, RI and also the PI were significantly higher inthe complicated pregnancy group as compared to the normal control group. They supportedthe use of spiral artery Doppler investigation for the noninvasive assessment of disturbancesoftrophoblasticinvasion in earlypregnancy.

OGomezetal[58]in2008concludedfromtheirstudythatthemeanUtA-PIshowsaprogressive decreaseuntilthe late stagesofpregnancy. Referencerangefor meanUtA-PImay have clinical value in screening for placenta-associated diseases in the early stages ofpregnancy, and in evaluating patients with pregnancy-induced hypertension and/or small-forgestationalagefetuses duringthe third trimester.

Deurloo et al[59] in 2009 found in results that a continuous decrease of the mean PI in the SAandUAwithincreasinggestationalage.TheyconcludedthatuterinearteryDopplermeasurement s in early pregnancy seem to accurately reflect peripheral resistance of SAs.Theyaddedthat,trophoblasticinvasionseemsacontinuousprocessinthefirsthalfofpregnancy, inwhich earlyUAbilateral notchingis aphysiologic event.

The findings of the presentstudysupport the use of spiral artery Doppler investigation(transvaginal) for the non-invasive evaluation of disturbances of trophoblastic invasion inearly pregnancy (6–10 weeks). The results suggest that the both the PI as well as RI aresignificantlyhigherinpatientspresentingwithfeaturesofthreatenedmiscarriageascompared to those with uncomplicated pregnancies. S/D Ratio in these groups were not foundtobestatisticallysignificant.In this studypatientswere followedtill20weeks and

association of adverse outcome with Doppler indices was studied. It was found that subchorionic hematoma and re-bleeding were found to be statistically significant in cases andcontrolat 20 weeks.No otherstudies followed patientsforadverseoutcomeat 20weeks.

TABLE30MEANAGEINDIFFERENTSTUDIES

AUTHOR	YEAR	n	MEANAGE/RANGEINYEARS
PRESENTSTUDY	2022	113	27.59 ± 3.08
ASEELGHAZIRIFATetal[64]	2020	85	27.7 ±5.1
PRIYANKAKUMARI etal[29]	2020	101	26.37±4.73
ROHITBHOILetal[63]	2019	50	26.8
JHAVANDANA et al[57]	2019	72	24.8
ZHENLIetal[65]	2017	80	32.6±1.7
DEURLOO[57]	2007	108	32.4
U¨UMMU¨O¨ZKAYA[56]	2006	100	25.6±4.4

- Themeanageofthepresentstudy was27.59± 3.08 which was statisticallysignificant.
- Most of the studies also found similar results except in studiesby ZHEN LI et al[65]andDEURLOO[57]wherethewomenwhocontinuedpregnancytill20weeksbelongedt o ahigher agegroup.(Table30).

OtherSociodemographicfactorslikereligion,Sociodemographicstatus,literacy,occupational status were not found to be statistically significant in both groups as found inDeulooet al, Priyankakumaraet aletc.

TABLE 31 MEAN GESTATIONAL AGE AT THE TIME OF FIRSTEPISODEOF BLEEDING

AUTHOR	YEAR	n	MEANPOG
PRESENTSTUDY	2022	108	7.81 ± 1.17
ROHITBHOILetal[63]	2019	50	6w5d
ASEELGHAZIRIFATetal[64]	2020	85	9w1d±2.5
U¨UMMU¨O¨ZKAYA[56]	2006	100	8w3d
JHAVANDANA et al[57]	2019	72	10w2d

- ThemeanPOGinourstudywasfoundtobe7.81±1.17.(asshowninTableII)

- In the study by ROHIT BHOIL et al[63] , majority of women had bleedingbetween 6-7 weeks. While the study by U¨UMMU O¨ZKAYAet al[56] foundmean period of gestation at bleeding to be 8w3d which was consistent with ourstudy.

TABLE 32 MEAN VALUE OF RI OF SPIRAL ARTERY IN DIFFERENTSTUDIES

AUTHOR	YEAR	MEANRI
PRESENTSTUDY	2022	0.795
ROHIT BHOILetal[63]	2019	0.48
DEURLOO[57]	2007	0.44
JHAVANDANA et al[57]	2019	0.72
K.Mäkikallio[10]	2004	0.46
OZHAN[61]	2015	0.70
OZKAYA[56]	2007	0.54

- The mean RI of Spiral artery in our study was found to be 0.795 which was consistentwith the studies of Jha Vandana[57] and Ozhan[61]. Other studies had lower mean RIvalues.(as shown in tableIV)
- Themean RIin our studywasfound to bestatisticallysignificant.

TABLE 33 MEAN VALUE OF PI OF SPIRAL ARTERY IN DIFFERENTSTUDIES

AUTHOR	YEAR	MEAN PI
PRESENTSTUDY	2022	0.89
ROHITBHOILetal[63]	2019	0.72
OZKAN[61]	2015	1.8
OZKAYA[56]	2007	0.82
DEURLOO[57]	2007	0.59
DEURLOO[59]	2009	0.54
K.Mäkikallio[10]	2004	0.80

- ThemeanPIvalueinourstudywasfoundtobe0.89whichwasfoundtobestatistically significant. OZKAYA et al[56] and K. Mäkikallioet al[10]also found similarvaluesofPIin their study.(As shown in tableV)
- OZHAN etal[61]found higher value ofPIin theirstudy(1.8)
- Other studies like DEURLOO et[al57]and DEURLOO et al[59] found lower values of PI intheirstudies.

TABLE34MEANS/DRATIOINDIFFERENTSTUDIES

AUTHOR	YEAR	MEANS/DRATIO
PRESENTSTUDY	2022	2.19
ASEELGHAZIRIFATetal[64]	2020	6.5
PRIYANKAKUMARI etal[29]	2020	2.56
ROHITBHOILetal[63]	2019	1.82
DEURLOO[57]	2007	1.75

- Themean S/Dratio in thepresent studyis 2.19 whichwas notstatisticallysignificant.
- RohitBhoiletal[63]andDeurloo[57]etalfoundsimilarresultswhileRifatetalfoundhighervalues ofmean S/D ratio.(TableIII)

We observed in the present study that subjects who presented with bleeding had disorderedspiral artery Doppler indices thus transvaginal color Doppler sonography may be used toevaluate spiral arterial blood flow dynamics in early pregnancy (6–10 weeks gestation); therewere also some limitations of using TVS Doppler. Technical limitations in assessing tinyvessels, like spiral arteries which can only be identified by an experienced radiologist, andTVSbeingahighlyoperator-dependentproceduremakingitmoredifficulttobeusedaloneas a deciding factor for identifying high risk patients. Despite these technical limitations it isstillapromisingtechniqueinassessingspiralarterialhemodynamicchangesinearlypregnancy,esp eciallyinhigh-risk patients.

SUMMARY

SUMMARY

Normal implantation and placentation are crucial for the successful outcome of pregnancy.Suboptimal implantation and placentation can result in miscarriage or complications in latepregnancy, like preterm delivery or preeclampsia [65]. Placentation provides uteroplacentalcirculation and allows the trophoblast to come in direct contact with maternal blood. Acombinationofcellularandmolecularsignalsaffectsimplantation.Blastocystinvasionincludes sex steroids, peptide hormones, growth factors, cytokines and immunological factors[66-68].Inadequateinvasion leads to miscarriage.

Information of normal maternal, uteroplacental and fetal hemodynamics and their physiologicchanges during the first trimester of pregnancy is crucial for understanding early humandevelopmentand manypregnancycomplications.,preeclampsiaorprematurebirth.

The aim of the study was to study the Color Doppler flowmetric indices of spiral artery bloodflow in first trimester (6–10 weeks) in cases of threatened abortion and normal pregnanciesandto predict the outcomeof such pregnancy.

This cross sectional studywas conducted in Santoshhospitalwith the aim to study the ColorDoppler flowmetric indices of spiral artery blood flow in first trimester (6–10 weeks) incasesof threatened abortion and normal pregnancies.

The sample size was 113 subjects with 55 women as cases who hadbleeding in firsttrimester of pregnancy at gestational age less than 10 weeks and 58 women without anybleeding per vagina during first trimester of pregnancy as control.Written informed consentwas taken before enrolling the women in study. The study was started after taking ethicalclearance. For study group eligible women with bleeding per vagina in pregnancy less than10weeks were enrolled.

A detailed history was taken including sociodemographic data, previous obstetric outcomeand parameters at the time of bleeding. Clinical, systemic and gynaecological examinationwasdoneforeachpatient.Routineandspecialinvestigationslikeultrasound(pelvis/transvaginal)weredonetoconfirmfetalviability,subchorionichaematomaandplacental localization.All women both study and control were followed till 20 weeks ofpregnancyand theirDopplerindices andoutcometill20 weeks werestudied.

Out of 113 women, 16 aborted in cases and 12 aborted in control till 20 weeks thereforeoutcomeofpregnancyat20weeks wascomparedwith39casesand46controls.

Thesociodemographicprofileoftwogroupswascompared.ThemeanAge±SDwas27.96+3.92int hecasegroupwhereasincontrolgroupthemeanwas27.59 ± 3.08. The groupswerestatisticallysignificant.

Maximum number of women in both groups belonged to hindu religion; 54.55% of casesand 48.27% of control respectively. 40% 0f cases and 37.93% of control were muslims.5.45%of cases and8.63%of control wereSikhs.

Maximumnumberofwomeninbothgroupsbelongedtolowermiddlesocioeconomicgroup 56.37% in cases and 44.83% in control respectively. The groups were not statisticallysignificantforsocioeconomicstatus.

Inthecontrolgroup40%whileincases43.10%hadschooleducation.Only14.55%ofcasesand18.9 6%ofcontrol wentto college.Thegroupswerenotstatisticallysignificant.

Most of the patients in both the groups were housewife; 58.18% of cases and 55.17% ofcontrol respectively. 34.55% of cases and 29.31% of control were unskilled workers. Therewasnostatisticaldifferenceintheoccupationbetweenthetwogroups.

Mostofthewomeninboththegroupsbelongedtourbanareas;67.27%ofcasesand68.96%ofcontrol respectively.Boththegroupswerenotstatisticallysignificant.

Maximum number of women in case group were primigravida 58.18% followed by 30.91%of cases with parity of one. In control group also maximum number of women wereparityof one 55.17% followed by primigravida 36.21%. Both the groups were not statisticallysignificant.

36.37% of cases and 37.93 % of control had one previous abortions. Majority of women i.e.63.63%of cases and62.07% of control hadno previous historyof abortions.

Therewasnostatisticaldifferenceinnumberofpriorabortionsbetweenboththegroups.

Majority of cases i.e. 61.82% of cases had no living issue where as majority of women incontrolgroup had onelivechild i.e. 55.17%ofcontrol.

Inthestudypopulation,therewasnostatisticaldifferenceinthenumberoflivingchildreninboth caseand control groups.

Thus it was found that there was no statistical difference in religion, socioeconomic status,literacy,occupation,residency,parity andpreviousobstetric outcomebetweenthe twogroups. ($p > 0.05$)

Majority of women in the cases presented with cramps 56.36% followed by backache 38.18%in theirfirst visit.

Majority of women in the control group presented with cramps 32.75% followed by backache20.68%intheirfirst visit.

The mean POG at which bleeding occurred was 7.81 ±1.17. Majority of cases of bleedingoccurred between 8-10 weeks 54.55%. The minimum gestation at which bleeding occurredwas6 weeks and maximum was 10 weeks 2 days.

Majority of women at the time of presentationin cases complained of severe bleeding(58.18%)followed by21.82%ofwomen with mild bleeding asper VAS scale.

In the study population, 83.64% of cases and 87.93% had no history of coitus ortrauma.

Ultrasound with doppler was advised for the study population at the time of their firstvisit. It was found that majority of cases (61.82%) and control (89.65%) had normalultrasoundfindings.Boththe groupswerestatisticallysignificant.

18.18% of cases and 1.72% of control had poor decidual reaction. Both the groups werecomparable and statisticallysignificant.

72.72% of cases and 3.44% ofcontrol had sub chorionic hematoma in their ultrasoundfindings.Their differencewas statisticallysignificant.

10.90% of cases and 3.44% of control had decreased FHR records in ultrasound. Thegroupswerenot statisticallysignificant.

9.09% of cases and 5.17% of control had growth lag. The two groups were comparablebutnot statisticallysignificant.

Doppler values of spiral artery and uterine artery were also calculated for both the groupsat the time of presentation. The mean PI of spiral artery in cases was 0.89±0.09 and incontrol was 0.7±0.06.PI was statistically significant in both the groups. The mean PI ofuterine artery was 2.7±0.45 in cases and in control was 2.15±0.35. PI ofuterine arterywasstatisticallysignificant in both thegroups.

The mean RI of spiral artery in cases was 0.8±0.09 and in control was 0.503±0.02. RI wasstatistically significant of spiral artery. The mean RI of uterine artery in cases was 0.8±0.1andin control was 0.7±0.15.RIwas statisticallysignificant ofuterineartery.

The mean S/D ratio of spiral artery in cases was 2.19±0.05 and in control was 2.16±0.05.The groups were not statistically significant. The mean S/D ratio of uterine artery in caseswas2.19±0.05and incontrol was2.16±0.04.Thegroupswerenotstatisticallysignificant.

Association of Amount of bleeding at presentation with Doppler studies at the time ofpresentation was studied and it was observed that the mean PI and RI value was increasedin patients with severe bleeding as compared with mild bleeding. S/D Ratio did not showanyrelation.

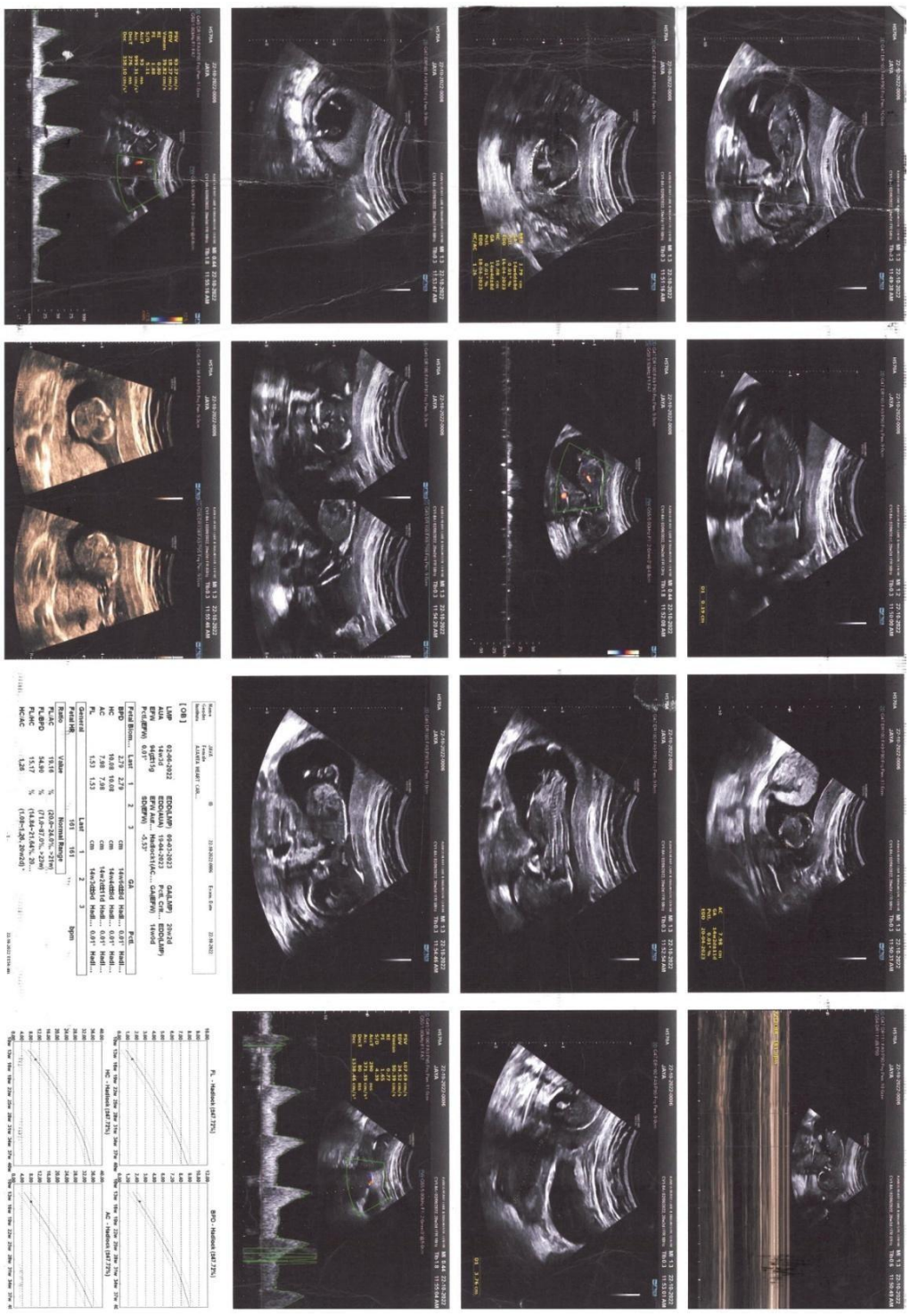
Outcome of both the groups at 20 weeks was studied. It was found that among the casesmajority (70.91%)had a viable pregnancy when followed them at 20weeks. Also, amongthe controls majority (79.31%) had a viable pregnancy at 20 weeks. Both the groups werenotcomparable.

Relation of abortion with spiral artery Doppler was observed. It was found that the meanRI among the cases who aborted was found to be 0.59±0.04 while in controls the mean RIwasfoundto be0.92±0.02. Thegroups werestatisticallysignificant.
The mean PI among the cases who aborted was found to be 0.48±0.03 while in controlsthemean wasfoundto be0.82±0.01.Thegroupswerestatisticallysignificant.
The mean S/D Ratio among the cases who aborted was found to be 1.9±0.03 while incontrolsthemeanwasfoundto be1.8±0.02. The groups werenot statisticallysignificant.

Women in both the groups were followed till 20 weeks and was found that majority ofcases (69.23%)had adverse pregnancy outcome while 26.09% of control had adversepregnancyoutcome. Thegroupswerestatisticallysignificant.

Distribution of outcome at 20 weeks in study population was followed and found that30.77%of cases haduncomplicatedviable pregnancywhile majorityof control (67.39%)

haduncomplicatedviablepregnancy.Thegroupswerefoundtobestatisticallysignificant.



UltrasoundFindingsatFirstTrimester

61.54% of cases had sub chorionic hematoma while only 4.35 % of control had sub chorionichematoma.The groupswere statisticallysignificant.

46.15%ofcaseshadrebleedingwhilenoneofthecontrolhadbleeding.Thegroupswerestatisticallysignificant.

Nostatisticalsignificancewasseeninleaking,HDP,lowlyingplacentaandgrowthlag.

Women followed at 20 weeks; 61.11%complained of mild re bleeding followed by 27.78% withmoderate re- bleeding and only 11.11% had severe re-bleeding. It was seen that the mean PI andRI and S/D ratio was increased in patients with severe re-bleeding as compared with mild re-bleeding.

Association of Sub chorionic hematoma with pregnancy outcome at 20 weeks was studied and nostatistical association of both groups with sub chorionic hematoma was seen with abortion,HDP,APH.

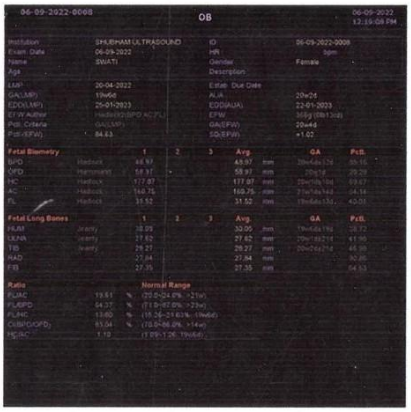
Amount of Re-bleeding was followed in the casesat 20 weeks and 61.11%complained of mildre bleeding followed by 27.78% with moderate re- bleeding and only 11.11% had severe re-bleeding

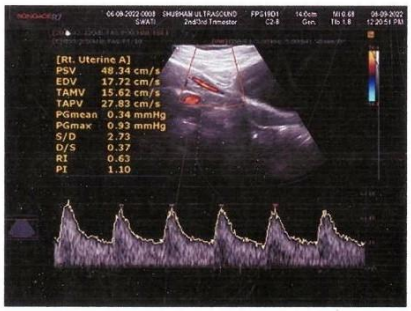
Association of Amount of Rebleeding at presentation with mean Doppler indices at 20 weekswas observed and it was found that the mean PI and RI and S/D ratio was increased in patientswithsevere re-bleedingascompared with mildre-bleeding.

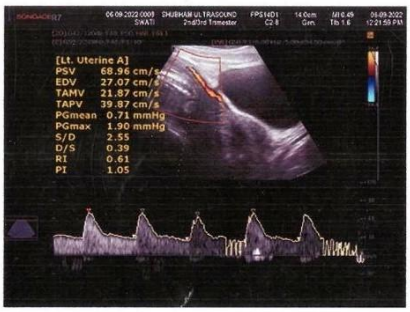
Association of Sub chorionic hematoma with pregnancy outcome at 20 weeks was studied and itwas found that41.67% of cases withsubchorionichematomaabortedat or before20 weekswhere as 50% of control with sub chorionic hematoma aborted at or before 20 weeks. The groupswere not statisticallysignificant.

33.33% of cases with sub chorionic hematoma had normal pregnancy and 50% of control hadnormal pregnancyat 20weeks. Thegroupswere notstatisticallysignificant.
Nostatistical significancewasseeninthesegroupsforHDPandAPH.

Association of Subchorionic hematoma with mean Doppler changes at 20 weeks was studied andwasfoundthatThemeanPIincaseswithSCHwas0.59±0.04andincases0.48±0.03.Thegroupswere comparable and werestatisticallysignificant.







Ultrasoundfindingsat20weeks

The mean RI in cases with SCH was 0.46±0.04 and in cases 0.41±0.03. The groups werecomparable and werestatisticallysignificant.

The mean S/D Ratio in cases with SCH was 0.19±0.04 and in cases 0.18±0.03. The groupswerecomparable but werenot statisticallysignificant.

Comparision between Spiral artery in early first trimester and Spiral artery at 20 weeks wasstudied and it was observed that there was a decrease in RI, PI and S/D ratio of spiral artery at20weeks ascomparedto first trimesterDoppler indicesin both casesandcontrol.

Thus, it was seen in the present study that bleeding in early pregnancy is associated with adverseoutcome at 20 weeks. Due to the high occurrence of spontaneous miscarriage in the threatenedabortiongroupofpatientsatechniquethatcouldpredictpregnancyoutcomeinearlygestationwouldbeofgreatclinicaladvantage.Thecapabilityoftrans-vaginalDopplersonographytoanalyzethepatternofcirculationineventerminalbranchesoftheutero placental circulation has encouraged research for its potential use in predicting early andlatepregnancycomplicationsrelatedtoabnormalplacentation.Impairedvascularremodelling in the maternal - fetal interface is one of the most significant factors associatedwith early and late complications in pregnancy[3,5-7].Hence, doppler ultrasound has developedasoneofthemostobjectivemethodstoassesspregnanciesatriskfororaffectedbypreeclampsia,intrauterinegrowthrestriction(IUGR),fetalanemia,andotheradverseperinataloutcomes.Dopplerultrasoundgivesknowledgeonfetalandplacentalcardiovascularfunction onthebasis ofthevascularresistanceofthevesselbeingassessed.

Proper counselling of these women needs to be done to make them understand that nofurther episode of bleeding is to be taken lightly and is to be reported to the healthcareprofessional. Higher incidence ofre bleeding and adverse outcome in this group has to beexplained.

CONCLUSION

CONCLUSION

Pregnancy related bleeding is a clinical challenge and is associated with significantmaternal morbidity. The probability of adverse pregnancy out come increases as theamount and duration of bleeding increases. Early recognition of women with bleedinginearlypregnancyandclassifyingthemas“highrisk”pregnanciesisimportant.Knowledgeoftheincreasedriskisassociatedwithearly pregnancy bleeding willfacilitatedecision makingregardingmanagement.

We carried out the present study so as to exhibit whether the possible modifications inbloodflowpatternsinspiralarteriescanbepickedupontrans-vaginalDopplerultrasound carried in the mid first trimester (6–10 weeks) and to investigate whethertheseDopplerfindings could predict adversepregnancyoutcome[63].

In the present study, we observed that despite similar demographic parameters in boththe groups, spiral artery PI and RI values in women presenting with vaginal bleedingweresignificantlyhigherthan in normal control females[63].

Thus,SpiralarteryDopplerhelpsinidentifyingthehighriskpatientsinearlypregnancy.Accordingly,itshouldbeintroducedasaroutinescreeningtestforidentifying these high risk women in early first trimester in order to offer effectiveprophylactic management strategies and for close monitoring and follow up of thesepatientsso as to haveasuccessful pregnancy.

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ANNEXURES

ANNEXURE1

PATIENTINFORMATIONSHEET

Name:

Age:Ad

dress:

RegistrationNumber:

Occupation:

PhoneNumber:

ChiefComplaints:

ProvisionalDiagnosis:

ANNEXURE10

CASESHEET

Type:Threatenedabortiongroup/Controlgroup Case

No.Patientsname

Age:

Husband‟sname:

Phoneno.

Address:

Menstrual:

LMP: EDD: POG(ATRECRUITMENT):

Complaints

Obstetrical History: G P L

AMedicalHistory:

Surgical

History:Others:

OBSERVATIONS:

POGatbleeding:

Associatedsymptoms:

Amountofbleeding:

Rebleeding:

GeneralExamination: Bleeding:

Mild/Moderate/HeavyP/A:

LocalExamination USGFindings:

P/S:

P/V:

AntenatalProfile

DopplerFlowmetricIndices:

1) Systolic/Diastolic(S/D)ratio:

2) ResistanceIndex(RI):

3) PulsatilityIndex(PI):

ANNEXURE109

INFORMEDCONSENT

Nameofthe patient:Age:

Address:

PhoneNumber:

S.No:Date:

I have been explained the details of the study entitled " Assessment of Colour DopplerFlowmetric Indices in First Trimester Threatened Abortion" and my questions regarding thestudyhavebeenanswered to mysatisfaction in a languageunderstood byme.

1. I understand that I have the right to withdraw from the study at anytime and to decline toanswer anyparticular question.

2. I understand that my participation in this study is confidential and that no material thatcouldidentifymewill beusedin theanalysisandin anyreports basedon thisstudy.

IherebyprovidemyconsentinthestudyentitledAssessmentofColourDopplerFlowmetric Indicesin FirstTrimesterThreatenedAbortion"

Signature/thumbimpressionofthepatient

Signature/thumbimpressionofwitness

स ूचि तसहम

ि तगाइडकाना

म: -रोगीकानाम:

आयु:

पता:-

फोननंबर:-

एसएनओ:

मुझेअध्ययनकेचिचरणसमझायागयाहै&"असेसमेंटऑफकलरडोप्पलरफ्लोमीिटटकइंिडकस इनफर्सटिटटमर्स्श्रीटेनेडएबॉटन".

मेराअध्ययनकेबारेमेंप्रश्नोंकोएकमेरेद्वारासमझाभाषामेंमेरीसंतुचिकाउत्तरचियागया

1.

मैंसमझताहंिकमुझेिकसीभीसमयअध्ययनसेचापसलेनेकाअचिकारहऔरिकसीचिर्ेषप्रश्काउत्तरचेनेमेंिगराचटआईहै

2.

मैंसमझताहंिकइसअध्ययनमेंमेरीभागीचारीगोपनीयहऔरसामग्रीजोमुझेपह ि ानसकतीहऔररपोटटइसअध्ययनकेचआारपरिकसीभीमेंचिश्लेषणउपयोगनहींकी जाएगी।मैंइसप्रकारअध्ययनमेंअपनीसहमित्तप्रानकरताहं"असेसमेंटऑफकलरडोप्प

ANNEXURE111

लरफ्लोमीिटरकइंिडकसइनफर्सटिटरमर्स्थीटेनेडएबॉरटन"

रोगीकेहर्सताक्षर/अंगूठेकीछाप

ANNEXURE11

EthicalCommitteeClearanceCertificate

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

F. No. SU/2021/1830[59] Dated: 17.07.2021

Subject: Grant of Ethical Clearance for Thesis Protocol Topic **"ASSESSMENT OF COLOUR DOPPLER FLOWMETRIC INDICES IN FIRST TRIMESTER THREATENED ABORTION"**, submitted by **Dr. Shubhangi Mishra,** MD/MS student of Batch 2020-2021, Department of **Obstetrics & Gynaecology**.

*****

With reference to his/her request for grant of Ethical Clearance for the Thesis Protocol entitled **"ASSESSMENT OF COLOUR DOPPLER FLOWMETRIC INDICES IN FIRST TRIMESTER THREATENED ABORTION"**, **Dr. Shubhangi Mishra** is informed that the Thesis Protocol submitted by him/her was considered by the **Screening Committee** of the Santosh Medical College & Hospital in its meetings held on 19.03.2021, 22.03.2021, 24.03.2021, 25.03.2021, 26.03.2021, 27.03.2021 and 06.04.2021. The recommendations of the **Screening Committee** were considered in detail by the Institutional **Ethics Committee** in its meeting held on **12.07.2021** and the same was **approved** by the **Ethics Committee**.

He /She is informed accordingly for further necessary action.

[Dr. V. P. Gupta]
REGISTRAR

SANTOSH DEEMED TO BE UNIVERSITY REGISTRAR GHAZIABAD, NCR DELHI

Dr. Shubhangi Mishra
MD/MS student of batch 2020-2021
Department of Obstetrics & Gynaecology
Email: shubhi19031994@gmail.com

Copy to:

1. The Vice Chancellor
2. The Dean, SMC&H
3. The Dean – Research
4. The Dean – Academics
5. The Director - IQAC
6. Dr. Manisha Gupta (Guide)
7. HOD of **Obstetrics & Gynaecology**

ANNEXURE113

PLAGARISMCERTIFICATE

Ouriginal
by Turnitin

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Analyzed document	Shubhangi Mishra.docx (D148493369)
Submitted	11/3/2022 5:27:00 AM
Submitted by	Dr Jyoti Batra
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INTRODUCTION

ANNEXURE114

KEYWORDTOTHEMASTERCHART

AGE–VALUEINYEARS

RELIGION-R

0- HINDU

1- MUSLIM

2- SIKH

3- CHRISTIAN

SES -

SOCIOECONOMICSTATUS0-

LOWER

1- LOWERMIDDLE

2- UPPERMIDDLE

3- UPPER

LIT-

LITERACY0-

ILLITERATE

1- SCHOOL

2- COLLEGE

OCCUPATION-

0-HOUSEWIFE

1- UNSKILLED

2- PROFESSIONAL

3-P-PARITY

H/o

COITUS0-

ABSENT

1-PRESENT

A-

ABORTIONSL-

LIVINGISSUE

POG–PERIODOFGESTTAIONATBLEEDINGINWEEKS

OUTCOMEA

BORTION-1

NORMALPREGNANCY-2

SYMPTOMS

S1–

CRAMPS0=

ABSENT

1=PRESENT

S2-

BACKACHE0=

ABSENT

1=PRESENT

S3-

FEVER0=A

BSENT

1=PRESENT

S4-

VOMITTING0=

ABSENT

1=PRESENT

RBPV-
REBLEEDINGPV1=PRE
SENT
0=ABSENT

AMOUNT-AMOUNTOFBLEEDING
(LIGHT/HEAVY)0= NOBPV
1=MILD
2=MODERATE
3=SEVERE

USG–
FIRSTTRIMESTERULTRASOUNDFINDINGS

CA- CARDIAC
ACTIVITY1=PRESENT
0=ABSENT

SCH-SUBCHORIONIC
HAEMATOMA1=PRESENT
0=ABSENT

LLP-
LOWLYINGPLACENTA1=PRESENT
0=ABSENT

ST- SPONTANEOUS
TERMINATION1=PRESNT
0=ABSENT

IT-
INDUCEDTERMINATION1=PRESENT
0=ABSENT

HDPat20weeks1
=PRESENT
0=ABSENT

LOCALITY
0=URBAN
1=RURAL

HDP=HYPERTENSIVE DISORDER OF
PREGNANCY1=PRESENT
0=ABSENT

ABRUPTION
1=PRESENT
0=ABSENT

PP-
PLACENTAPREVIA1=
PRESENT
0=ABSENT

L-
LEAKING1=
PRESENT
0=ABSENT

INVESTIGATIONS

Hb – haemoglobin in

gm%Plt-platelet in

lacs/mm^3

TLC-totalleukocytecountinmm^3

OUT- OUTCOME AT 20

WEEK0=NORMALPREGNAN

CY

1=ABORTION

2=LOWLYINGPLACENTA

3=RE-BLEEDING

4=HDP

5=LEAKING

6=EXPULSION

DR-DECIDUALREACTION

0=GOODDECIDUALREACTION

1=POORDECIDUALREACTION

S.NO	OPD.No	AGE	R	SES	LIT	O	LOC	P	SYMPTOMS				C/T	POG	BPV	ULTRASOUND	DOPPLER												INVESTIGATION	OUT SCH	ULTRASOUND at 2(	DOPPLER								
																MGA	FHR(	Deci	PI			RI			S/D ratio			PI			RI			S/D Ratio						
																			Lt SpA	Rt SpA	Lt SpA	Rt SpA	Lt SpA	Rt SpA	Lt SpA	Rt SpA	Lt UtA	Rt UtA	Lt UtA	Rt UtA	Lt UtA	Rt UtA		MGA	FHR	DR	PI		RI		S/D ratio	
									S1	S2	S3	S4																							Lt SpA	Rt Spa	Lt SpA	Rt SpA	Lt SpA	Rt SpA
1	2E+07	19	0	1	1	0	0	1	1	0	0	0	0	9w3d	0	9w1d	172	0	0.702	0.67	0.53	0.52	1.6	2	2.1	2.4	0.8	0.72	5.4	5.89	hb10,plt1.24,tlc8200	0	0	19w2d	160	0	0.55	0.52	0.37	0.39	0.18	0.19
2	2E+07	26	0	2	1	0	0	0	0	0	0	0	0	10w2d	0	9w6d	170	0	0	0.7	0.703	0.48	0.52	2.5	2.3	2.2	2	0.72	0.71	5.8	5.9	hb9.5,plt2.24,tlc7200	0	0	20w1d	154	0	0.49	0.48	0.39	0.42	0.26	0.28
3	2E+07	22	0	3	2	0	1	1	0	0	1	0	0	7w3d	0	8w0d	180	0	0.703	0.691	0.56	0.52	1.4	1.6	2	2.1	0.71	0.73	5.7	5.84	hb11,plt1.24,tlc8000	0	0	20w3d	146	0	0.45	0.52	0.37	0.39	0.18	0.16
4	2E+07	17	1	0	1	0	0	0	0	0	1	0	0	8w	0	9w0d	164	1	0.704	0.68	0.5	0.49	1.8	2.3	1.9	2.2	0.74	0.69	5.69	5.89	hb12,plt3.14,tlc9200	1	0								
5	2E+07	26	0	4	0	1	1	1	1	1	0	0	0	9w4d	0	8w6d	176	0	0.71	0.702	0.46	0.49	2.6	2.2	1.89	1.98	0.81	0.68	5.87	5.91	hb9.5,plt3.4,tlc1100	0	0	19w2d	157	0	0.49	0.48	0.41	0.42	0.24	0.18
6	2E+07	19	3	1	2	2	0	1	1	0	0	0	0	8w1d	0	7w5d	165	0	0.705	0.691	0.55	0.54	2.3	2.5	2.3	1.88	0.76	0.71	5.7	5.92	hb10.5,plt2.5,tlc4800	0	0	20w1d	147	0	0.52	0.54	0.41	0.42	0.26	0.24
7	2E+07	25	1	1	1	0	1	0	1	0	1	0	0	6w6d	1	5w5d	154	0	0.69	0.689	0.47	0.49	1.5	1.8	2.1	2.1	0.69	0.72	5.8	5.89	hb11.5,plt2.2,tlc8300	0	0	19w3d	156	0	0.45	0.48	0.37	0.39	0.18	0.17
8	2E+07	26	1	0	0	0	0	0	1	0	1	0	0	7w5d	0	8w0d	178	0	0.703	0.699	0.53	0.52	2.7	1.8	2	2.2	0.71	0.701	5.7	5.96	hb9.5,plt1.24,tlc8879	0	0	19w3d	160	0	0.55	0.53	0.43	0.42	0.24	0.2
9	2E+07	20	1	1	0	2	1	2	0	0	0	0	0	6w2d	0	6w1d	145	0	0.707	0.693	0.54	0.52	1.8	2.4	2.2	1.89	0.68	0.75	5.697	5.8	hb11,plt1.24,tlc7987	0	0	20w5d	154	0	0.46	0.48	0.39	0.37	0.19	0.22
10	2E+07	25	1	1	0	0	0	1	1	1	0	0	0	8w2d	0	7w4d	160	0	0.692	0.701	0.47	0.49	1.4	1.8	1.9	2.1	0.72	0.72	5.9	5.78	hb9,plt2.24,tlc8977	0	0	19w4d	129	0	0.49	0.47	0.39	0.38	0.17	0.2
11	2E+07	26	0	0	0	0	0	0	0	0	1	0	0	9w3d	0	7w4d	187	0	0.692	0.692	0.49	0.47	2.8	2.6	1.7	2.3	0.69	0.7	5.8	5.82	hb9.8,plt2.94,tlc9800	0	0	18w5d	156	0	0.55	0.52	0.39	0.37	0.24	0.28
12	2E+07	26	0	1	1	2	1	1	0	0	0	0	0	9w9d	0	9w2d	178	0	0.705	0.685	0.53	0.54	2.2	2.3	2.2	2.1	0.68	0.71	5.7	5.87	hb10.8,plt2.29,tlc678	0	0	19w5d	144	0	0.49	0.48	0.43	0.41	0.26	0.26
13	2E+07	28	0	0	0	1	0	1	1	1	0	0	0	7w5d	0	8w2d	167	0	0.706	0.703	0.55	0.53	1.9	2.19	2	2.2	0.71	0.73	5.76	5.83	hb7.8plt2.47,tlc8776	0	0	18w4d	136	0	0.45	0.48	0.52	0.58	0.28	0.24
14	2E+07	30	0	1	2	1	0	1	0	0	0	0	0	10w4d	0	9w4d	166	0	0.708	0.693	0.5	0.51	1.8	2.1	2.1	2.14	0.7	0.72	5.78	5.78	hb9.8,plt1.66,tlc7887	0	0	19w6d	145	0	0.49	0.54	0.37	0.42	0.24	0.27
15	2E+07	30	1	0	1	0	1	1	0	1	0	1	1	6w4d	0	6w6d	180	0	0.709	0.701	0.47	0.48	1.9	2.2	2.2	2.18	0.69	0.71	5.81	5.82	hb10.5,plt2.4,tlc9880	0	0	20w3d	150	0	0.48	0.49	0.42	0.39	0.24	0.22
16	2E+07	28	1	0	1	0	1	1	0	1	0	0	0	9w1d	0	10w0d	175	0	0.706	0.684	0.49	0.46	2.4	2.16	2.3	2.2	0.71	0.69	5.83	5.78	hb10.3,plt1.24,tlc877	0	0	19w6d	136	0	0.49	0.48	0.4	0.39	0.24	0.24
17	2E+07	28	0	1	1	0	0	1	1	0	0	0	0	8w2d	0	8w6d	150	0	0.705	0.697	0.51	0.5	2.5	2.16	2.1	2.19	0.68	0.71	5.71	5.81	hb10.5,plt1.45,tlc998	0	0	20w5d	146	0	0.49	0.52	0.38	0.42	0.24	0.26
18	2E+07	30	0	1	1	1	0	0	1	1	0	0	0	7w4d	0	8w2d	167	0	0.69	0.71	0.52	0.53	2.13	1.9	2.2	2.1	0.7	0.73	5.81	5.82	hb9.7,plt2.84,tlc5678	0	0	18w6d	160	0	0.46	0.49	0.39	0.4	0.2	0.18
19	2E+07	32	0	0	0	1	0	1	1	0	0	0	0	7w6d	0	8w3d	158	0	0.704	0.704	0.53	0.54	1.8	1.6	2.4	2.14	0.73	0.732	5.67	5.83	hb9.5,plt2.24,tlc8989	0	0	19w5d	158	0	0.48	0.49	0.39	0.42	0.16	0.18
20	2E+07	28	0	0	0	1	0	0	1	1	1	0	0	8w4d	0	8w2d	165	0	0.704	0.693	0.5	0.48	1.7	2.19	2.1	2.18	0.68	0.729	5.78	5.81	hb9.57plt2.2,tlc7868	0	0	18w4d	136	0	0.48	0.5	0.38	0.39	0.24	0.22
21	2E+07	29	1	1	1	1	0	1	0	0	0	0	0	6w6d	0	7w2d	178	0	0.72	0.704	0.53	0.49	2.4	2.3	2	2.1	0.69	0.73	5.89	5.79	hb11,plt1.76,tlc8768	0	0	19w3d	144	0	0.52	0.54	0.39	0.43	0.24	0.22
22	2E+07	27	1	1	1	0	1	1	1	1	0	0	0	8w6d	0	9w2d	158	0	0.689	0.679	0.51	0.53	2.3	2.2	1.9	2.14	0.71	0.701	5.8	5.81	hb9.9,plt1.24,tlc8877	5	1	20w3d	136	0	0.49	0.52	0.39	0.42	0.22	0.24
23	2E+07	34	0	1	2	0	1	1	0	1	0	0	0	9w5d	0	9w3d	178	0	0.702	0.694	0.49	0.48	2.6	2.6	1.8	2.19	0.72	0.72	5.79	5.79	hb10.8,plt2.49,tlc678	0	0	18w5d	148	0	0.48	0.45	0.42	0.44	0.26	0.24
24	2E+07	30	0	0	0	2	0	1	0	1	0	0	0	10w2d	0	9w5d	148	0	0.72	0.691	0.5	0.47	2.3	2.3	2.1	2.2	0.7	0.74	5.69	5.82	hb11.5,plt2.49,tlc877	0	0	19w4d	158	0	0.49	0.52	0.38	0.39	0.26	0.22
25	2E+07	26	2	0	0	2	0	1	1	0	0	0	0	7w3d	0	7w3d	159	0	0.7	0.7	0.52	0.5	1.3	1.7	2.2	2.19	0.72	0.73	5.9	5.8	hb12,plt1.4,tlc7869	0	0	20w4d	159	0	0.49	0.47	0.42	0.41	0.2	0.18
26	2E+07	27	0	0	1	1	0	1	0	0	0	0	0	6w4d	0	6w5d	184	0	0.71	0.698	0.47	0.48	1.6	2.13	2.3	2.2	0.7	0.72	5.78	5.69	hb12,plt3.4,tlc7656	0	0	20w	160	0	0.49	0.52	0.39	0.4	0.18	0.16
27	2E+07	27	0	1	1	0	0	0	0	0	1	0	0	7w3d	0	7w6d	175	0	0.704	0.68	0.49	0.46	2.4	2.5	1.9	2.1	0.701	0.71	5.87	5.803	hb12,plt1.67,tlc4567	0	1	19w3d	142	0	0.52	0.54	0.38	0.42	0.26	0.22
28	2E+07	27	1	3	2	1	0	1	0	0	0	0	0	7w5d	0	8w1d	168	0	0.69	0.7	0.52	0.54	1.5	2.1	1.78	2.14	0.701	0.7	5.8	5.789	hb12,plt3.4,tlc6767	1	0								
29	2E+07	28	1	1	1	1	0	0	1	1	0	0	0	8w3d	0	8w4d	175	0	0.707	0.693	0.48	0.47	1.8	2.4	2.1	2.18	0.7	0.731	5.9	5.76	hb8.5,plt2.76,tlc6778	0	0	19w2d	138	0	0.53	0.54	0.43	0.41	0.22	0.24
30	2E+07	29	1	1	1	0	1	0	0	0	0	0	1	9w6d	0	10w0d	169	0	0.708	0.702	0.5	0.49	2.3	1.8	2.3	2.17	0.73	0.734	5.78	5.87	hb10.8,plt1.87,tlc897	0	0	19w4d	160	0	0.54	0.52	0.37	0.38	0.26	0.24
31	2E+07	26	3	3	2	1	1	1	0	0	0	0	0	8w4d	0	9w1d	178	0	0.73	0.71	0.52	0.49	1.9	1.8	2	2.1	0.71	0.729	5.87	5.79	hb12,plt2.49,tlc7889	0	0	18w4d	153	0	0.49	0.52	0.37	0.38	0.18	0.2
32	2E+07	34	1	1	0	0	1	1	1	0	0	0	0	7w5d	0	8w0d	175	0	0.68	0.7	0.49	0.48	2.4	1.9	2.13	1.9	0.7	0.72	5.89	5.89	hb9.5,plt3.45,tlc5687	2	0	19w3d	138	0	0.52	0.5	0.42	0.39	0.22	0.18
33	2E+07	26	1	1	2	0	1	0	0	0	0	0	0	8w4d	0	8w3d	188	0	0.705	0.703	0.5	0.52	2.4	2.7	1.89	1.89	0.69	0.73	5.87	5.87	hb9.5,plt2.24,tlc6757	2	0	20w2d	145	0	0.51	0.52	0.38	0.41	0.24	0.24
34	2E+07	29	1	1	2	0	0	1	0	0	0	0	0	9w3d	0	9w2d	164	0	0.707	0.691	0.49	0.53	2.5	2.6	2.23	2.3	0.7	0.732	5.78	5.78	hb8.8,plt1.46,tlc8788	0	0	20w3d	154	0	0.51	0.48	0.4	0.42	0.22	0.24
35	2E+07	34	2	1	1	0	0	1	0	0	0	0	1	6w2d	0	7w0d	165	0	0.707	0.691	0.47	0.49	1.3	1.7	2.2	2.1	0.7	0.732	5.81	5.805	hb10.5,plt2.47,tlc9878	0	0	18w3d	145	0	0.52	0.51	0.41	0.38	0.16	0.18
36	2E+07	26	0	1	1	0	0	0	0	0	0	0	0	9w4d	0	6w1d	189	0	0.7	0.701	0.52	0.5	1.7	1.9	2.12	2.2	0.71	0.71	5.79	5.788	hb12,plt2.24,tlc4578	0	0	19w4d	156	0	0.54	0.52	0.39	0.41	0.18	0.16
37	2E+07	26	0	1	1	1	0	1	0	0	0	0	0	10w3d	0	9w6d	167	0	0.706	0.692	0.51	0.53	2.6	2.2	2.21	1.99	0.71	0.72	5.79	5.87	hb7.8,plt1.24,tlc7899	2	0	19w3d	143	0	0.49	0.48	0.39	0.42	0.24	0.24
38	2E+07	23	0	1	1	0	0	1	0	0	0	0	0	7w0d	0	7w2d	158	0	0.708	0.701	0.49	0.48	1.8	2.3	1.98	2.3	0.7	0.71	5.82	5.78	hb7.5,plt2.48,tlc9854	0	0	20w1d	158	0	0.52	0.54	0.39	0.43	0.2	0.24
39	2E+07	22	1	0	1	0	0	0	1	0	0	1	0	9w4d	0	9w2d	175	0	0.691	0.692	0.49	0.48	1.7	1.8	1.87	2.1	0.69	0.72	5.83	5.79	hb11,plt2.45,tlc9878	0	0	20w3d	156	0	0.5	0.53	0.41	0.43	0.16	0.18
40	2E+07	29	3	0	0	0	0	0	0	0	0	0	0	8w5d	0	8w4d	178	0	0.705	0.73	0.53	0.55	2.4	2.2	2.1	2.15	0.689	0.73	5.831	5.9	hb10,plt2.46,tlc7899	0	0	19w4d	147	0	0.49	0.48	0.39	0.38	0.26	0.22
41	2E+07	27	1	0	0	2	0	1	0	0	0	0	0	10w2d	0	10w1d	156	0	0.709	0.689	0.51	0.49	2.3	2.5	2.21	2.18	0.71	0.731	5.78	5.8	hb10.5,plt2.49,tlc768	0	0	18w3d	156	0	0.52	0.54	0.42	0.43	0.24	0.18
42	2E+07	24	2	1	2	2	1	0	0	0	0	1	0	7w5d	0	8w0d	166	0	0.69	0.693	0.5	0.53	2.4	2.2	2.2	2.2	0.7	0.734	5.9	5.78	hb9.9,plt1.76,tlc1899	0	0	19w3d	147	0	0.47	0.49	0.38	0.39	0.24	0.26
43	2E+07	23	0	0	0	0	0	1	2	1	0	1	0	8w6d	0	9w1d	176	0	0.707	0.682	0.5	0.49	2.4	2.5	2.13	2.1	0.69	0.725	5.7	5.82	hb9.5,plt2.46,tlc9289	0	0	19w5d	142	0	0.48	0.49	0.39	0.42	0.26	0.23
44	2E+07	24	0	2	2	2	1	1	0	0	0	0	0	8w6d	0	9w0d	178	0	0.706	0.691	0.49	0.54	2.6	2.18	2.21	2.17	0.74	0.732	5.9	5.803	hb8.9,plt1.49,tlc6799	0	0	20w1d	160	0	0.52	0.49	0.39	0.4	0.18	0.19
45	2E+07	26	0	1	1	1	0	2	0	0	1	0	1	9w5d	0	6w2d	101	0	0.707	0.702	0.47	0.46	1.8	1.9	1.98	2	0.67	0.73	5.8	5.79	hb12.7,plt2.49,tlc989	0	0	19w4d	147	0	0.49	0.52	0.39	0.43	0.22	0.2
46	2E+07	22	2	0	1	0	0	0	0	0	0	0	0	9w3d	0	9w4d	176	0	0.701	0.69	0.48	0.54	1.7	1.9	1.89	1.9	0.704	0.734	5.5	5.79	hb11,plt1.24,tlc6788	0	0	19w5d	160	0	0.46	0.48	0.39	0.42	0.2	0.18
47	2E+07	23	1	0	0	0	0	0	1	1	0	0	0	6w6d	0	7w1d	164	0	0.702	0.701	0.55	0.48	2.2	2.1	2.3	1.89	0.7	0.729	5.8	5.805	hb10.5,plt1.78,tlc786	0	0	20w2d	148	0	0.49	0.51	0.37	0.39	0.25	0.24
48	2E+07	25	1	0	0	2	0	0	1	1	0	1	0	9w	0	8w6d	167	0	0.702	0.69	0.49	0.46	2.4	2.3	2.1	2.1	0.708	0.73	5.4	5.79	hb10.5,plt2.4,tlc6758	0	0	19w4d	154	0	0.49	0.52	0.39	0.4	0.24	0.26
49	2E+07	24	1	0	0	1	0	0	0	0	0	0	0	8w3d	0	8w6d	170	0	0.702	0.68	0.54	0.51	2.4	2.5	2.2	2.17	0.69	0.731	5.81	5.804	hb11.8,plt2.43,tlc987	1	0								
50	2E+07	23	1	0	0	1	0	1	1	1	0	0	0	7w6d	0	8w0d	184	0	0.69	0.7	0.53	0.49	1.7	1.5	2.1	2.2	0.703	0.728	5.79	5.79	hb9.9,plt1.87,tlc4677	0	0	20w3d	129	0	0.47	0.49	0.38	0.4	0.18	0.16
51	2E+07	21	0	0	0	1	0	1	1	1	0	0	0	8w5d	0	9w0d	103	0	0.706	0.692	0.52	0.54	1.5	1.7	1.89	2.18	0.7	0.719	5.82	5.89	hb9.8,plt2.67,tlc7844	0	0	19w4d	138	0	0.51	0.53	0.42	0.41	0.18	0.18
52	2E+07	24	0	0	0	0	0	0	0	0	0	0	0	7w1d	0	7w0d	177	0	0.706	0.691	0.47	0.48	1.9	1.9	2.2	2.17	0.689	0.731	5.81	5.82	hb12,plt2.49,tlc6788	0	0	18w3d	144	0	0.48	0.49	0.39	0.44	0.23	0.22
53	2E+07	25	0	0	0	0	0	0	0	0	0	0	0	9w2d	0	7w1d	189	0	0.708	0.702	0.47	0.48	1.9	1.7	1.88	2.1	0.706	0.728	5.83	5.801	hb10.5,plt1.76,tlc956	4	0	20w3d	161	0	0.51	0.53	0.38	0.42	0.23	0.19
54	2E+07	19	0	1	0	0	0	0	0	0	1	0	1	7w3d	0	8w0d	170	0	0.69	0.685	0.52	0.49	2.3	2.18	2.4	2.2	0.7	0.72	5.791	5.804	hb10.7,plt1.5,tlc9590	0	0	19w2d	142	0	0.52	0.54	0.38	0.42	0.23	0.22
55	2E+07	22	1	0	1		0	1	1	1	0	0	0	8w2d	0	9w	160	0	0.72	0.693	0.55	0.47	1.8	1.7	2.1	2.1	0.701	0.719	5.801	5.79	hb8.8,plt1.24,tlc5787	0	0	18w4d	160	0	0.52	0.51	0.42	0.44	0.23	0.18
56	2E+07	18	0	1	0	0	1	1	1	0	1	0	0	9w2d	0	8w4d	154	0	0.701	0.687	0.48	0.48	2	1.8	2.2	1.9	0.72	0.72	5.801	5.801	hb9.5,plt2.24,tlc7876	0	0	19w4d	154	0	0.48	0.47	0.39	0.42	0.18	0.19
57	2E+07	26	2	0	2	0	1	2	0	1	1	1	0	7w6d	0	8w2d	167	0	0.701	0.696	0.48	0.53	1.6	2.4	2.21	2.2	0.69	0.74	5.87	5.8	hb10.5,plt1.3,tlc8400	0	0	20w3d	149	0	0.49	0.51	0.37	0.39	0.22	0.24
58	2E+07	24	0	2	1	1	0	1	0	1	0	1	0	6w6d	0	7w3d	177	0	0.706	0.693	0.52	0.55	1.6	2.7	2	2.1	0.7	0.731	5.78	5.769	hb9,plt1.24,tlc5200	0	0	18w2d	156	0	0.49	0.48	0.38	0.42	0.18	0.22

S.NO	OPD NO	AGE	R	SES	LIT	O	P	LOC	SYMPTOMS				C/T	POG	BPV	ULTRASOUND	DOPPLER												INVESTIGATION	OUT SCH	ULTRASOUND at 2(	DOPPLER								
																MGA	FHR	Decid	PI			RI			S/D Ratio			PI			RI			S/D Ratio						
																			Lt SpA	Rt SpA	Lt SpA	Rt SpA	Lt SpA	Rt SpA	Lt SpA	Rt SpA	Lt UtA	Rt UtA	Lt UtA	Rt UtA	Lt UtA	Rt UtA		MGA	FHR	DR	PI		RI		S/D ratio	
									S1	S2	S3	S4																							Lt SpA	Rt Spa	Lt SpA	Rt SpA	Lt SpA	Rt SpA
1	2E+07	18	0	1	1	0	0	0	0	0	0	0	0	7w2d	1	7w5d	170	0	0.901	0.97	0.67	0.76	2.18	1.9	2.5	2.81	0.79	0.81	5.7	5.7	hb9.5,plt2.76,tlc5643	1	1								
2	2E+07	19	0	0	0	0	0	0	1	0	0	1	0	8w2d	1	7w4d	182	1	0.54	0.52	0.76	0.78	2.7	2.3	2.59	2.79	0.81	0.8	5.9	5.81	hb10.5,plt3.24,tlc6700	3,4	1	20w3d	162	0	0.48	0.5	0.42	0.46	0.26	0.28
3	2E+07	32	0	2	2	2	2	1	1	0	1	0	0	6w5d	2	7w2d	172	0	0.93	0.95	0.65	0.67	2.4	2.1	2.61	2.72	0.82	0.82	5.8	5.78	hb11,plt3.45,tlc8760	4	0	20w3d	146	0	0.46	0.48	0.37	0.39	0.18	0.16
4	2E+07	18	2	0	2	0	0	0	0	1	0	1	0	8w5d	2	9w1d	182	0	0.89	0.95	0.76	0.89	1.8	1.8	2.603	2.77	0.81	0.83	5.9	5.87	hb9.5,plt1.89,tlc9860	5	0	20w1d	147	0	0.76	0.79	0.5	0.52	0.26	0.24
5	2E+07	19	0	0	0	0	0	1	1	0	0	1	0	6w0d	3	6w2d	177	0	0.9	0.92	0.85	0.88	1.9	2.4	2.56	2.83	0.81	0.78	5.79	5.79	hb8.5,plt1.40,tlc8700	4,5	1	20w1d	147	0	0.76	0.79	0.49	0.55	0.26	0.24
6	2E+07	34	0	1	0	0	2	1	1	0	1	0	0	6w3d	1	6w6d	173	0	0.93	0.99	0.83	0.86	1.9	1.9	2.602	2.81	0.82	0.81	5.8	5.8	hb9.5,plt3.24,tlc9876	0	0	20w1d	147	0	0.55	0.52	0.38	0.41	0.26	0.24
7	2E+07	31	0	1	0	0	1	1	0	1	0	1	0	6w3d	3	6w6d	104	0	0.48	0.5	0.89	0.87	2.3	2.4	2.59	2.71	0.78	0.85	5.79	5.79	hb11,plt2.84,tlc9200	0	1	19w3d	156	0	0.49	0.47